

THE
PHILOSOPHICAL
TRANSACTIONS

(*From the Year 1720, to the Year 1732*)

A B R I D G E D,

AND

Dispos'd under GENERAL HEADS.

BY

Mr. REID and JOHN GRAY, A. M. F. R. S.

VOL. VI. Part II, III, IV.

L O N D O N:

Printed for WILLIAM INNYS and RICHARD MANBY,
Printers to the *Royal Society*, at the West End of *St. Paul's*.

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PART II.

Containing the

Physiological PAPERS.

CHAP. I.

Physiology, Meteorology, Pneumatics.

HAVING poured equal measures of mercury and water separately into two thin florence flasks, I set them at an equal depth in a pail of boiling water for five minutes; then taking them out I plung'd each of them into a cylindric vessel that contained three pints of cold water, and examined the heat communicated to it with a thermometer; which in the vessel where the flask with the water stood rose two degrees, and in the other still three degrees higher; being again put into the first it fell four degrees, and in the other rose almost three.

This shews that more heat is communicated by warm mercury than by an equal bulk of water equally warmed; and therefore, that there is more matter in the mercury.

An Experiment to prove an interspersed Vacuum.
 By Dr. J. T. Desaguliers.
 n. 365. p. 81.
 May, &c.
 1720.

Of the cohesion of

*Experiments
of the cohesion
between a
board and the
surface of wa-
ter. By Dr.
B. Taylor. n.
368. p. 207.
May, &c.
1721.*

II. 1. I took several very thin pieces of fir-board, and having hung them successively in a convenient manner to a nice pair of scales, I tried what weight was necessary (over and above their own, after they had been well soaked) to separate them at once from the surface of stagnating water. I found 50 grains to separate a surface of one inch square, and the weight in every trial exactly proportional to the surface. The distance of the under surface of the board from the surface of the water, at the time they separated, I found to be $\frac{1}{10}$ of an inch; though I believe it would be found greater, if it could be measured at a greater distance from the edge of the board than I could, the water rising a little before it came quite under the edge.

*Fig. 1.
Experiments
concerning the
cohesion of
lead. By Dr.
J. T. Desagu-
liers, after
Mr. Triewald
n. 389. p. 345.
July, &c.
1725.*

2. I took the leaden balls A and B, the first weighing one and the other two pounds; and having from each of them cut off a segment of about $\frac{1}{4}$ inch in diameter, I pressed them together with my hand, giving them a little twist to bring the flat parts to touch as well as I could. The balls stuck so fast, that when the hand H by means of a string sustained the upper ball A, the lower one B (by its contact at C) was sustained, though loaded with the scale S and weights E, which amounted to 16 pounds. A little more weight separated them, and upon viewing the touching surfaces it appeared that they did not exceed a circle of $\frac{1}{10}$ inch diameter; but this surface can hardly be measured exactly on account of its irregularity. The experiment was repeated several times, and the cohesion of the balls was different every time.

Fig. 2.

I made the experiment also in the following manner. On the upper pin or bar of the wooden frame D d I H, I suspended the steelyard E F, whose hook held up a leaden ball A of two inches in diameter, having an hole through it at a to receive a string; the lower ball B equal to, and prepared in the same manner as the first, received the pin O o through its string, so that G the weight of the steelyard was made use of to separate the balls, which it did when it was applied at the number 20 in the first experiment; but in the three following the balls were not separated till the weight was removed to the numbers 25, 37, and 45, expressing pounds on the steelyard.

Lastly, having applied the balls together as before, still cleaning the surface of contact with my knife, and never making it sensibly greater than what I mentioned, the weight G being removed quite to the end F, where it weighed 47 pounds, did not separate the balls, so that I was obliged to make use of another steelyard; but by mistake I applied a wrong weight instead of G, which being of 7 pounds instead of 4 separated the balls. Having found the right weight afterwards I made several trials, but could not again bring the force of the contact to be equal to 47 pounds.

the parts of matter.

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3. Quer. 1. Does not this strong cohesion of two balls of lead prove that there is an universal attraction between the parts of matter, though in some at such small distances as to escape our observation, since we cannot make their parts touch one another close enough to come within their sphere of activity? This I presume to be the reason why I never have been able to make balls of any other metals to cohere; nor do I believe that the parts of any other metal can come to such a close contact, except by fusion, as those of lead may, by being so many degrees softer than any other metal.

Queries concerning the cause of cohesion of the parts of matter. By Mr. Martin Tricwald, n. 408. p. 39. March, &c. 1729.

Quer. 2. I have often found the touching surfaces of such leaden balls, as near as I could measure, much alike, yet the force of cohesion very different; nay, I have found the touching surfaces very small, yet sometimes 114 to 126 lb weight has not been sufficient to separate them; when at other times a much less weight has effected it, though the measure of the touching surfaces far exceeded those mentioned. Does it not prove that the cohesion is according to the closeness of the contact, but not as the touching surfaces? For which reason I have always found the cohesion strongest, when I gave a little twist in joining them; since by this means the particles must come closer together, than by squeezing the balls barely on one another, though it were done with a far greater force than I could apply with my bare hands. And since the force, twist and touching surfaces can never be alike and mensurable when joined by hand, I think it will be very difficult, if not impossible, to ascertain the force of this cohesion, which is incredible, and far exceeds magnetical attraction. The pressure of the atmosphere contributes little, and next to nothing in this cohesion, for two leaden balls, which 126 lb could not separate, cohered as strongly in vacuo as in the open air.

Quer. 3. Does not this experiment shew that the cohesion of the parts of matter cannot be derived from any glue or cement, any imaginary hooks and funiculi, nor the weight of the atmosphere, but that the particles of all solid and fluid bodies do attract one another by a certain force (whatever be the cause of that force) which acts more intensely the nearer they touch one another?

I am confirmed in this opinion by an experiment which our Dalkarlians have, time out of mind, practised when they have had occasion to remove any unweildy stones of the hardest rocks, and so big as not to be moved entire by any strength they could apply. They not only cleave and split them into as many pieces as they please, but obtain stones with one or more smooth sides, fit for use in buildings, by the following means.

They take tallow, grease, train-oil, or any other fat substances, and draw lines on the stone where they would have it split; then they lay either char-coal or wood at top and round the sides of it, so that it is all over covered, and kindle the fuel; which when burnt out, they seldom

or never fail to find the stone divided according to the lines they had drawn on it.

May one not account for this odd phenomenon thus? That the action of the fire about the stone having made its particles recede farther from one another than when in their natural state, the oily substances insinuate themselves between them; by which means, when the stone cools again and shrinks, they are prevented from coming so close as the other particles where no such foreign matter was applied; hence they cannot attract one another so strongly as the rest, and must therefore remain separated. Fat and oily substances seem to be most fit for this purpose, being endued with a repelling force.

New and curious electrical experiments. By Mr. Stephen Gray. n. 366. p. 104. Sept. &c. 1720.

III. 1. Having often observed in the electrical experiments made with a glass tube and a down feather tied to the end of a small stick, that after its fibres had been drawn towards the tube, when that was removed most of them would be drawn to the stick, as if it had been an electric body, or as if there had been some electricity communicated to the stick or feather: This put me upon thinking, whether if a feather were drawn through my fingers, it might not produce the same effect, by acquiring some degree of electricity. The experiment succeeded, the small downy fibres of the feather next the quill being drawn by my finger when held near it; and sometimes the upper part of the feather with its stem would be attracted also, but not always nor equally. I proceeded to try whether hair might not have the same property; I took one from my wig, and after drawing it three or four times between my thumb and fore-finger, it would come to my finger at the distance of half an inch. Upon taking the ear of a Dog and drawing it through my fingers, great numbers of the fine hairs would be attracted to them at once. Threads of silk of several colours and of several finenesses I found to be all electrical, though sometimes I was disappointed; the reason of which will appear in the sequel.

Having succeeded so well in these, I proceeded to larger quantities of the same materials, as pieces of ribband both of coarse and fine silk of several colours, and found that by taking a piece of either of these of about half a yard long, and by holding the end in one hand, and drawing it through my other hand between my thumb and fingers, it would acquire an electricity, so that if the hand were held near the lower end of it, it would be attracted by it at the distance of five or six inches. But at some times the electricity would be much weaker than at others, the reason of which I conjectured to be, that the ribband had imbibed some aqueous particles from the moist air, which I found upon trial to be true; for when I had well warmed it by the fire, it never failed to be strongly electrical.

After this I tried several other bodies, as linnen of several sorts, viz. holland, muslin, &c. woollen of several sorts, cloth and other stuffs

electrical experiments.

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stuffs of the same materials. From these I proceeded to paper, both white and brown, and found that after they had been well heated before rubbing, they emitted copiously their electric effluvia. Fir-shavings are strongly electrical: leather, parchment, and those thin guts wherein leaf-gold is beaten, have also the same property.

All these bodies will not only by their electricity be drawn to the hand or any other solid body that is near them, but they will, as other electric bodies do, draw all small bodies to them, and that sometimes at the distance of 8 or 10 inches. Heating them by the fire before rubbing very much increases their force.

There is another property in some of these bodies which is common to glass, that when they are rubbed in the dark there is a light follows the fingers through which they are drawn. This holds both in silk and linnen, but is strongest in pieces of white pressing papers, which are much the same with card-paper; the last not only yields such a light, but when the fingers are held near it, there proceeds a light from it with a crackling noise like that produced by a glass tube, though not at so great a distance from the fingers; but the paper before rubbing must be heated as hot as the fingers can well bear.

A down feather being tied to the end of a fine thread of raw silk, fastened at the other end to a small stick, which was fixed to a foot that it might stand upright on the table; I took a piece of brown paper, which by the above-mentioned method being made strongly electrical, and held near the feather, it was drawn to the paper; and I carried it with the same 'till it came near the perpendicular of the stick; then lifting up my hand till the paper was got beyond the feather, the thread was extended and stood upright in the air, as if it had been a piece of wire, though the feather was distant from the paper near an inch. If the finger were held near the feather in this position, the greatest part of the fibres next the paper would be repelled, when at the same time if a finger were held to the fibres that were more remote from the paper they would be drawn by it.

I then repeated this experiment without the feather, by a single thread of silk only of about five or six inches long, which was made to stand extended upright, without touching the paper; then placing my finger near the end it was repelled by it; but when I placed it at the same distance from a part of the thread that was about two inches from the end, it was attracted.

I next made several attempts on metals, to see whether they also might not be made attractive by heating, rubbing and hammering; but without any success. I then resolved to procure me a large flint-glass tube, to see if I could make any farther discovery with it; having called to mind a suspicion which I had some years ago, that as the tube communicated a light to bodies when it was rubbed

*Continued
and improv-
ed, by the
same. n. 417.
p. 18.
Jan. 1766.
1731.*

in

in the dark, it might at the same time communicate an electricity to them, though I never 'till now tried the experiment, not imagining the tube could have so great and wonderful an influence, as to cause them to attract with so much force, or at such prodigious distances, as will be found in the sequel of this discourse.

Before I proceed to the experiments it may be necessary to give a description of the tube: Its length is three feet five inches, and near one inch two tenths in diameter: I give the mean dimensions, the tube being larger at each end than in the middle, the bore about one inch. To each end I fitted a cork, to keep the dust out when the tube was not in use.

The first experiment I made was to see if I could find any difference in its attraction, when the tube was stopped at both ends by the corks, or when left open; but could perceive none: for upon holding a down-feather over-against the upper end of the tube, it was attracted and repelled by the cork, as by the tube when it had been excited by rubbing. I then held the feather over-against the flat end of the cork, which attracted and repelled many times together; at which I was much surprized, and concluded that there was certainly an electric vertue communicated to it by the excited tube.

Having by me an ivory ball of about one inch three tenths diameter, with a hole through it, I fixed it upon a fir-stick about four inches long, thrusting the other end into the cork, and upon rubbing the tube found that the ball attracted and repelled the feather with more vigour than the cork had done, repeating its attractions and repulsions for many times together. I then fixed the ball on longer sticks, first upon one of eight inches, and afterwards upon one of twenty-four inches long, and found the same effect. Then I used first iron and next brass wire to fix the ball on, inserting the other end of the wire in the cork as before, and found the attraction the same as when the fir-sticks were made use of, and that when the feather was held over-against any part of the wire it was attracted by it; but though it was then nearer the tube, yet the attraction was not so strong as that of the ball. When a wire of two or three foot long was used, its vibrations caused by rubbing the tube made it somewhat troublesome to manage. This put me upon thinking, whether if the ball were hung by a packthread and suspended by a loop on the tube, the electricity would not be carried down the line to the ball: accordingly upon suspending the ball on the tube by a packthread about three foot long, when the tube had been excited by rubbing, the ivory ball attracted and repelled the leaf-brass over which it was held, as freely as it had done when it was suspended on sticks or wire: a ball of cork and another of lead weighing one pound and a quarter did the same.

After

electrical experiments.

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After I had found that the several bodies above-mentioned had an electricity communicated to them, I went on to see upon what others the tube would have the same effect, beginning with the metals, which I suspended on the tube by the method above-mentioned; first in small pieces, as a guinea, a shilling, a half-penny, a piece of block-tin, a piece of lead; then in larger quantities, such as a fire-shovel, tongs, and iron poker, a silver pint pot, a copper tea-kettle, which succeeded equally whether empty or full either of cold or hot water: all these were strongly electrical, attracting the leaf-brass to the height of several inches. I next tried other bodies, as flint-stone, sand-stone, load-stone, bricks, tiles, chalk; and then several vegetable substances, as well green as dry, and found that they had all of them an electric virtue communicated to them, either by being suspended on the tube by a line, or fixed on the end of it.

I next proceeded to try to what greater distances the electric virtue might be carried, and having by me part of a hollow walking cane two foot seven inches long, I cut the great end of it to fit it into the bore of the tube, into which it entered about five inches; and the tube being excited, the cane drew the leaf-brass to the height of more than two inches, as did also the ivory ball, when by a cork and stick it had been fixed to the end of the cane. A solid cane had the same effect, when inserted in the tube after the same manner as the hollow one had been. I then took the two upper joints of a large fishing-rod, the one of Spanish cane, the other partly wood the upper end being whale-bone, which, together with the tube, made a length of more than fourteen foot. Upon the lesser end of the whale-bone was fixed a ball of cork of about an inch and quarter diameter; the great end of this rod being inserted in the tube, the leaf-brass laid on the table, and the tube excited, the ball attracted the leaf-brass to the height of about three inches. With several pieces of Spanish cane and fir-sticks I afterwards made a rod, which together with the tube was somewhat more than eighteen foot long, the greatest length I could conveniently use in my chamber, and found the attraction very nearly if not altogether as strong, as when the ball was placed on shorter rods.

May 14th, 1729, between six and seven o'clock in the evening, being in the country, I provided a rod of about twenty-four foot, that consisted of a fir-pole, a piece of cane, and the top of reed, upon the end whereof the ball of cork was placed; and the great end of the rod being put into the tube about seven or eight inches, the leaf-brass being laid down, and the tube rubbed, the ball attracted and repelled the leaf-brass with vigour; so that it was not at all to be doubted but with a longer pole the electricity would have been carried much farther.

May

May the 16th, I made a rod thirty-two foot long including the tube; the bigger part of it was a fir-staff about six foot and a half long, the rest was of cane, and the top of it reed. All things being prepared as before, the effect was the same as in the last experiment, only the pole bending and vibrating by rubbing the tube made it more troublesome to manage. This put me upon making the following experiments.

May the 19th, about six in the morning, the ivory ball being suspended on the tube by a line of pack-thread twenty-six foot long, which was the height I stood at in a balcony from the court where he stood that held the board with the leaf-brass on it; the tube being rubbed, attracted the leaf-brass to the height of near two inches, as he that assisted informed me. This was repeated with the cork ball with the same success.

May the 31st, in the morning, to a pole of eighteen foot I tied a line of thirty-four foot in length; so that the pole and line together made fifty-two foot. With the pole and tube I stood in the balcony, and the assistant below in the court where he held the board with the leaf-brass on it; then the tube being excited as usual, the electric virtue passed from the tube up the pole, and down the line to the ivory ball which attracted the leaf-brass, and as the ball passed over it in its vibrations the leaf-brass would follow it 'till it was carried off the board: but these experiments are difficult to make in the open air, the least wind carrying away the leaf-brass.

Some time after I made several attempts to carry the electric virtue in a line horizontally, since I had not an opportunity of carrying it from greater heights perpendicularly; but without success, occasioned by my using improper materials, as will appear from what follows. The first method I tried was by making a loop at each end of a line, one of which I hung on a nail drove into a beam; the other hung downwards, and through it I put the line with the ivory ball, the other end of it being hung by a loop on the tube; so that the part of the line next the ball hung perpendicular, the rest of it lay horizontal: then the leaf-brass being placed under the ball and the tube rubbed, yet not the least sign of attraction was perceivable. Upon this I concluded that when the electric virtue came to the loop that was suspended on the beam, it went up the line to the beam; so that none, or very little of it at least, came down to the ball, which was afterwards verified, as will appear by the experiments mentioned hereafter. Upon this I gave over any farther attempts to carry the electricity horizontally, designing at my return to London, if I could get assistance, to have tried the experiment from the top of the cupola of St. Paul's, not doubting but the electric attraction would be carried perpendicularly down from thence to the ground.

June

June 30. 1729. I went to Otterden-Place to wait on Mr. Wheler, carrying with me a small solid glass cane of about eleven inches long, and $\frac{3}{4}$ of an inch in diameter, with some other requisite materials, designing only to give a specimen of my experiments. The first was from the window in the long gallery that opened into the hall, about sixteen foot high; the next from the battlements of the house down into the fore court, twenty-nine foot; then from the clock-turret to the ground, which was thirty-four foot, this being the greatest height we could come at: and notwithstanding the smallness of the cane, the leaf-brass was attracted and repelled beyond what I expected. As we had no great heights here Mr. Wheler was desirous to try whether we could not carry the electric vertue horizontally. I told him of the unsuccessful attempt I had made, and the method and materials I had used. He then proposed a silk line to support that by which the electric vertue was to pass. I told him it might do better upon the account of its smallness; so that there would be less vertue carried from the line of communication.

Accordingly an experiment was made July 2. 1729. at ten in the morning. About four foot from the end of a gallery there was a cross line fixed by its ends to each side of the gallery with two nails; the middle part of the line was silk, the rest at each end packthread. The line to which the ivory ball was hung, and by which the electric vertue was to be conveyed to it from the tube, being 80 $\frac{1}{2}$ foot in length, was laid on the cross silk line so that the ball hung about nine foot below it. The other end of the line was by a loop suspended on the glass cane, and the leaf-brass held under the ball on a piece of white paper; when the tube being rubbed the ball attracted the leaf-brass and kept it suspended on it for some time.

This experiment succeeding so well, and the gallery not permitting us to go any farther in one length, Mr. Wheler thought of an expedient for encreasing the length of our line, by putting up another cross line near the other end of the gallery; over the silk part of both the lines we laid a line of communication long enough to be returned to the other end where the ball hung: and though now both ends of the line were at the same end of the gallery, yet care was taken that the tube was far enough off from having any influence upon the leaf-brass, except what passed by the line of communication. Then the cane being rubbed, and the leaf-brass held under the ivory ball, the electric vertue passed by the line of communication to the other end of the gallery, and returned back again to the ivory ball which attracted the leaf-brass and suspended it as before. The whole length of the line was 147 foot.

We then thought of trying whether the attraction would not be stronger without doubling or returning the line, which we found means of doing in the barn, where we had one of 124 foot long, fourteen foot of which hung perpendicular from the silk line; and now the attraction was stronger than when the line was returned, as in the gallery.

July 3. Having now brought with me the great glass tube, between ten and eleven in the morning, we went again into the barn, and repeated the last mentioned experiment with both the tube and cane; but the attraction was not so strong as in the evening before, nor was there so great a difference in the attraction communicated by the solid cane and glass tube as one would have expected, considering the difference of their lengths and diameters.

We then proceeded farther by adding so much more line as would make a return to the other end of the barn, the whole length of it being now 293 foot; and though it was so much lengthened we found no sensible difference in the attraction. This encouraged us to add another return; but upon beginning to rub the tube, our silk lines broke, being too weak to bear the weight of the line, when shaken with the motion given it by rubbing the tube. Upon this, having brought with me both brass and iron wire, instead of the silk we put up small iron wire; but that also was too weak to bear the weight of the line. We then took brass wire of a somewhat larger size than that of iron. This supported our line of communication; but though the tube was well rubbed yet there was not the least attraction even with the great tube. By this we were now convinced that our former success depended upon the lines that supported the line of communication being silk, and not upon their being small, as before trial I imagined; the same effect happening here as when the line that is to convey the electric virtue is supported by packthread; viz. that when the effluvia come to the wires or packthread that support the line, they pass by them to the timber to which each end of them is fixed, and so go no farther forward in the line that is to carry them to the ivory ball.

Finding that our silk threads were too weak to bear many returns of line, Mr. Wheler thought of another way of managing them; which was by placing two other cross lines some feet below the upper ones, so that every other turn of line was suspended by the lower cross lines. By this contrivance we could add a much greater length of line without danger of breaking our silk; there being but half the weight of line upon each silk that there was when we used only two cross lines. We then put up a line that was 666 foot in length, by eight returns. The leaf-brass being held on a piece of white paper under the ivory ball, and the tube with the other end of the line suspended on it being rubbed for some time, the leaf-
brass

brass was attracted as manifestly as it had been with much shorter lines. We repeated the experiment with the little short solid cane, and found there was somewhat of an attraction, but not near so great as with the large tube.

Though the going and returning of the electric effluvia was very surprising, yet we were willing to try how far the attractive virtue might be carried in a continued right line; which we did thus: That end of the line where the attraction was to be made, was suspended on a silk line that was fixed cross a garret window about forty foot high. About 100 foot from hence two poles of about ten foot long were drove into the ground, so that they stood nearly perpendicular and at two foot distance from each other. Beyond these, at the same distance from the first, were another pair of poles fixed; then four others at a like distance. Upon the ends of these poles were tied the cross lines of silk to support the line of communication, which being laid on the silk lines, the ivory ball hanging in the garret window and the other end of the line being hung by a loop on the tube, the leaf-brass was held under the ball, and after the tube had been rubbed for some time they called to me to let me know that there was an attraction of the leaf-brass. This was several times repeated with success; then Mr. Wheler came into the field and rubbed the tube himself, that I might see there was an attraction; which I saw, though I perceived it not so strong as when the attraction was carried by a longer line returned; the length of this being only 650 foot. This was several times repeated, but the experiment being made in the evening at length the dew fell. We began about seven, or some little time after, and before eight the attraction ceased: But whether this was caused by the dew falling or by my being very hot we could not be sure, though I rather imputed it to the latter.

Though we call the carrying the electric virtue by the lines in this position horizontal, you are not to understand it in a strict sense, as may be easily perceived; and as the line swagged down considerably below the silk lines that supported it, it was some feet longer than the distance of the poles.

Some days after, this experiment was repeated from the turret closet window with a line of 765 foot, and the attraction was no less perceivable than in the experiment above-mentioned.

A large map of the world twenty-seven foot square, a table-cloth fifty-nine foot square, being suspended on the tube by packthreads became electrical. An umbrella suspended by a packthread tied to the handle of it became strongly electrical.

Large surfaces impregnated with electric effluvia.

A loadstone that had a small key hanging by its armour was suspended on the tube by a packthread; then the tube being rubbed,

The electric virtue not at all interrupted by magnetic effluvia.

the key and stone both attracted the leaf-brass in the same manner as other bodies do.

Carried several ways at the same time, and to considerable distances.

There were made three stands, each composed of two upright pieces of fir fixed perpendicular near the ends of a long board and distant from each other almost a foot and half: upon the tops of these were tied threads of silk to support the lines of communication between the tube and the attracting bodies. One of these stands was placed in the great parlour, near the farther end; another in the little parlour, and a third in the hall which was between the two parlours. As the other two were one of them to the right, the other to the left hand, this last was placed near the hall-window forwards; the two first were about fifty foot, the other about twenty foot from the place where the tube was held: then three small square pieces of wood were tied to three lines of packthread about the lengths above-mentioned. They were laid on the silk lines, and by loops at the other ends were suspended on the tube; then the leaf-brass being held under the pieces of wood, and the tube rubbed, they all of them attracted the leaf-brass at the same time. Some time after Mr. Wheler tried a red hot poker, and found the attraction the same as when cold. He also suspended a live chick upon the tube by the legs, and found its breast strongly electrical.

Carried from the tube, by only being held near the line of communication, without touching it.

I took a piece of a hair-line, such as linnen-cloaths are dried on, of about eleven foot in length; which, by a loop at the upper end of it, was suspended on a nail in one of the rafters in the garret, and had at its lower end a leaden weight of fourteen pounds hung to it by an iron ring: then the leaf-brass was laid under the weight, and the tube being rubbed and held near the line without touching it, the lead-weight attracted and repelled the leaf-brass for several times together, to the height of at least three, if not four inches. If the tube was held three or four foot above the weight there would be an attraction; but if it were held higher up, so as to be near the rafter where the weight was hung by the hair-line, there would be none.

Carried several ways at the same time by a line of communication, without touching it.

There were taken two hair-lines between four and five foot long; to each of these a square piece of cork was tied by packthread; the lines were suspended by loops at their upper ends upon two nails; near the lower ends there was tied to the hair-lines a piece of packthread by which there was a communication between the two hair-lines; then the leaf-brass being laid under the corks, the tube rubbed and held near one of the lines, both the corks attracted; but that which was farthest much stronger than that near which the tube was held. About the middle of the line of communication they both drew with equal force.

There

There were made two cubes of oak of about six inches square, the one solid, the other hollow : these were suspended by two hair-lines, nearly after the same manner as in the experiment above-mentioned ; the distance of the cubes from each other was by estimation about 14 or 15 foot ; the line of communication being tied to each hair-line and the leaf-brass placed under the cubes, the tube was rubbed and held over the middle of the line, and, as near as could be guessed, at equal distances from the cubes, when both of them attracted and repelled the leaf-brass at the same time, and to the same height ; so that there seemed to be no more attraction in the solid than in the hollow cube. Yet I am apt to think that the electric effluvia pass through all the interior parts of the solid cube, though no part but the surface attracts ; for from several experiments it appears, that if any other body touches that which attracts, its attraction ceases till that body be removed and the other be again excited by the tube.

Electric attraction not proportional to the quantity of matter in bodies.

I next proceeded to try if the electric vertue might not be conveyed to a rod, without touching it or inserting it into the bore of the tube ; which I found to succeed by suspending the rod either by lines of silk or by pieces of horse-hair fishing-lines, placing a ball of cork on the lesser end of the rod.

I took a large pole 27 foot long, two inches and a half diameter at the great end, and at the lesser about half an inch : it was that sort of wood they call horse-beech, with the rind on. This was suspended by two hair-lines of about four foot and a half in length ; the first line was about two foot from the great end of the pole, the other about eight foot from the lesser end ; so that the pole hung horizontal. At the little end of the pole was hung a ball of cork about an inch and a half diameter by a packthread about a foot long, with a small leaden ball upon the cork to keep the packthread extended. Then the leaf-brass being laid under the cork, the tube rubbed and held near the great end of the pole, the cork ball drew the leaf-brass strongly to the height of an inch, if not more : the leaf-brass being held under several parts of the pole was attracted by it, but not near so strongly as by the cork.

I took a hoop of about two foot two inches diameter and suspended it by a hair-line upon a nail drove into a beam ; the line was about four foot long ; the leaf-brass being laid under the hoop, the tube was rubbed and held within the hoop near the upper side of it, without touching it by several inches : then the lower part of the hoop attracted and repelled the leaf-brass strongly ; but when held near the lower part there was very little, if any attraction. If the tube was held near the out-side of the hoop it attracted ; but strongest when at the same time it was held near the knot of the hair-line by which the hoop was suspended. To this hoop there was tied a lesser one of about a foot and a half diameter ;

The electric effluvia carried in a circle, and communicated from one circle to another.

diameter; it was fastened by packthread so as to hang below it about two inches; they were suspended together by a hair line: then the leaf-bras and the tube being prepared as before, the tube being held near the upper hoop, the lower part of the lower hoop attracted strongly; when held near the upper part of the lower hoop, but very weakly; when held near the lower part of the lower hoop, there was no attraction at all.

They have the same effect in a circle, when its position is horizontal.

I took a large hoop of somewhat more than three foot diameter, and about two inches and a half broad; to this we tied, at near equal distances, four lines of what they call twine, being three threads of packthread twisted together, each about two foot eight inches long. These were tied with their ends together to a hair-line of about two foot and a half long by which the hoop was hung on a nail as in the other experiments, so that it hung now in an horizontal position. Then the leaf-bras being laid under the edge of the hoop at between two or three inches below it, the tube being rubbed and held between the cords without touching them, the leaf-bras was attracted and repelled for several times together; but when held near the out-side of the hoop, opposite to that part where the leaf-bras lay, the attraction was much stronger.

May be communicated to vegetables;

About the latter end of autumn and the beginning of winter 1729, I resumed my enquiry after other electric bodies, to see what addition I could make to the catalogue of those mentioned above, and found many more that have the same property and may be excited to attract by the same method: as for instance, the dry withered leaves of reeds and flags, grass and corn, both leaves and straw; the leaves of trees, as those of the laurel, the oak, the walnut, the chesnut, hazelnut, apple and pear-tree leaves; so that we may conclude that the leaves of all vegetables have this attractive vertue.

And to fluids;

March 23. 1730. having dissolved soap in the Thames water I suspended a tobacco-pipe by a hair-line, so as that it hung nearly horizontal with the mouth of the bowl downwards; then having dipped it in the soap-liquor and blown a bubble, the leaf-bras being laid on a stand under it and the tube rubbed, the bras was attracted by the bubble when the tube was held near the hair-line. I repeated the experiment with another bubble, holding the tube near the little end of the pipe, and the attraction was now much greater, the leaf-bras being drawn up to the height of near two inches.

March 25. I repeated this experiment after a somewhat different manner. The pipe was now suspended by two lines of white sewing-filk of about five foot and a half long: these were hung by loops upon two nails drove into the beam of my chamber about two foot distant from each other; then the bubble being blown, by holding the tube to the little end of the pipe the bubble attracted the leaf-bras to the height of near four inches.

April

electrical experiments.

15

And to animal bodies.

April 8. 1730. I made the following experiment on a boy between eight and nine years of age. His weight with his cloaths on was 47 pounds ten ounces. I suspended him in a horizontal position by two hair-lines, such as cloaths are dried on, which were about thirteen foot long with loops at each end. There were drove into the beam of my chamber, which was a foot thick, a pair of hooks opposite to each other, and two foot from these another pair in the same manner. Upon these hooks the lines were hung by their loops so as to be in the manner of two swings, the lower part hanging within about two foot of the floor of the room. The boy was laid on these lines with his face downwards, one of the lines being put under his breast, the other under his thighs. Then the leaf-brass was laid on a stand, which was a round board of a foot diameter with white paper pasted on it, supported by a pedestal of a foot in height, which I often made use of in other experiments. Upon the tube's being rubbed and held near his feet without touching them, the leaf-brass was attracted by the boy's face with much vigour, so as to rise to the height of eight, and sometimes ten inches. I put a great many pieces on the board together, and almost all of them came up at the same time. Then the boy was laid with his face upwards, and the hind part of his head which had short hair on it attracted, but not at quite so great a height as his face did. The leaf-brass being placed under his feet, with his shoes and stockings on, and the tube held near his head his feet attracted, but not altogether at so great a height as his head. The leaf-brass was again laid under his head and the tube held over it, but there was then no attraction, nor was there any when the leaf-brass was laid under his feet and the tube held over them.

April 16. I repeated the experiment with the boy, but now the attraction was not quite so strong as at the first, the brass not rising higher than to about six inches. His hands being stretched nearly horizontal, I placed a small stand with leaf-brass under each hand, and under his face the great one furnished as the others; when the excited tube being held near his feet there was an attraction by his hands and face at the same time. I then gave him the top of a fishing-rod to hold in his hand; there was a ball of cork stuck on the little end of it, under which the leaf-brass being laid, and the tube rubbed and held near his feet, the ball attracted the leaf-brass to the height of two inches, and repelled it and attracted it for several times together with great vigour.

April 21. I again repeated the experiment on the boy; and now he attracted much stronger than at the first: the leaf-brass rose to his face at the height of more than twelve inches. Then I gave him to hold in each hand the tops of two fishing-rods, with a ball of cork on each of their lesser ends; then a small stand being set under each ball with the leaf-brass on it, the tube being rubbed and held near his

his feet, both the corks attracted and repelled together strongly. The poles were each of them about seven foot long. Then the boy was laid on his left side, and a fishing-rod of near twelve foot in length given him to hold with both his hands; at the end of the rod there was a small ball of cork an inch and three quarters diameter: things being thus prepared and the tube held near the boy's feet, the cork-ball attracted and repelled the leaf-brass with force to the height of at least two inches.

When I speak of holding the tube near the boy's feet, I mean over against the soles of his feet; and when near his head, over against the crown of his head; for when the tube is held above, or over his legs, the attraction is not so strongly communicated to the other parts of his body.

By these experiments we see that animals receive the greatest quantity of electric effluvia, and that they may be carried from them several ways at the same time to considerable distances, wherever they meet with a passage proper for their conveyance.

Besides the large stand abovementioned I made use of two small ones, the tops of which were three inches diameter; they were supported by a column of about a foot in height, their bases of about four inches and a half; they were turned of lignum vitæ; their tops and bases made to skrew on for convenience of carriage; upon the tops were pasted white paper. When the leaf-brass is laid on any of these stands, I find it is attracted to a much greater height than when laid on a table, and at least three times higher than when laid on the floor of a room.

The electric effluvia very strong, and carried to great lengths, without touching the line by the tube.

I took a line of packthread 231 foot in length, supported on two cross lines of blue silk distant near eighteen foot from each other. About four foot below one of these lines was put up another silk line of the same colour; to this was tied one end of the packthread; at the other end hung the ivory ball; the line was returned over the cross lines thirteen times; then the leaf-brass being laid under the ball upon one of the small stands, and the tube excited and held near the end of the line, the ball attracted and repelled to the height of one of its diameters, which was about an inch and a quarter.

I have by several trials lately made found that rubbing the tube and putting it up between the returns of the line in several places, before I go with it to the end of the line, much facilitates the attraction, and causes it much sooner than when one stands with the tube and applies it to the end of the line only.

How far they may be carried forward in a line, without touching it.

I carried the line out of a window into a garden, and down a great field before it. It was supported by fifteen pair of poles; each pair had a line of blue silk tied from one pole to the other, the length about four foot, equal to the distance of the two poles. About ten foot from the window there was a silk line put cross the room

room, upon which that part of the line hung that had the ivory ball on it. Below the cross line of the farthest pair of poles was placed another cross line, four foot from the ground, to which was fastened the other end of the communicating line, as in the experiment above. Then the leaf-brass and tube being prepared as usual, and the tube held over the line at several distances, beginning towards that end where the ball hung, and so proceeding towards the farther end of the line, the leaf-brass was attracted at stations not exceeding two or three hundred foot pretty strongly; but still grew weaker as we came towards the farther end of the line whose length was 886 foot: yet even at the end of it the leaf-brass would be lifted by the ball, when the tube touched the line.

I should now have given some account of the discovery I made last year concerning the attraction of coloured bodies, which is greater or less according to the colours they are of, though the substance be the same and of equal weight and bigness; but I shall only observe that I find the red-orange or yellow attract at least three or four times stronger than green, blue or purple. But having very lately found out a new and more accurate method of making these experiments, I must beg leave to proceed farther before I communicate them.

IV. I provided a good linseed oil thermometer, which I marked with small divisions, not equal in length, but equal according to the capacity of the tube in the several parts of it, as all thermometers ought to be graduated. I likewise provided two vessels of thin tin, of the same shape, and equal in capacity, containing each about a gallon. Then (observing in every trial, that the vessels were cold, before the water was put in them, as also that the vessel I measured the hot water with, was well heated with it) I successively filled the vessels with one, two, three, &c. parts of hot boiling water, and the rest cold; and at last with all the water boiling hot; and in every case I immersed the thermometer into the water, and observed to what mark it rose, making each trial in both vessels for the greater accuracy. And having first observed where the thermometer stood in cold water, I found that its rising from that mark, or the expansion of the oil, was accurately proportional to the quantity of hot water in the mixture, that is to the degree of heat.

V. Exitus experimentorum ope thermometri e mercurio præparati factorum sequenti continetur tabula, cujus prima columna exhibet liquores adhibitos; secunda illorum gravitatem specificam; tertia gradum caloris ad quem unusquisque liquore bulliendo pertigit.

VOL. VI. PART II. C Liquores

An experiment proving the expansion of the liquor in the thermometer to be as the degree of heat. By Dr. Brook Taylor, n. 376. p. 291. March, &c. 1723.

Experiments of the degrees of heat in boiling liquors By D. G. Fahrenheit, n. 381. p. 1. Jan. &c. 1724.

Liquores.	Gravitas specifica liquorum ad 48 gr. calidorum.	Gravitas ebullitione acquisti.
Spiritus vel al- cohol vini. }	8260	176
Aqua pluvia.	10000	212
Spiritus nitri.	12935	242
Lixivium cine- ris clavellati. }	15634	240
Ol. vitrioli.	18775	546

Gravitatem specificam cujusque liquoris addendam judicavi, ut aliorum experimenta a memoratis differrent, colligi possit an e variatione gravitatis specificæ, vel ex aliis causis differentia petenda sit. Experimenta præterea non eodem tempore sunt facta, & inde etiam liquores vario temperamenti vel caloris gradu erant affecti, sed quoniam illorum gravitas diversimode & inæqualiter turbatur, calculo illorum gravitatem revocavi ad 48 gradum qui in thermometris meis medium tenet locum inter terminum intensissimi frigoris arte confecti, commixtione sc. aquæ, glaciei, salisque armoniaci, vel etiam maritimi, & terminum caloris qui in sanguine hominis sani reperitur.

Olea volatilia gradu certo quidem incipiunt ebullire, sed eorum calor ebulliendo semper augetur. Cujus rei causa fortasse erit, quod nempe volatiliores particulæ avolent, dum resinosa majori attractione præditæ restant.

Olea fixa autem tanto calore afficiuntur, ut mercurius in thermometro simul cum illis ebullire incipiat, & inde eorum calor hoc modo vix explorari poterit.

Si spiritum vini & aquam excipias, fortasse etiam gradus coeterorum liquorum hic commemoratorum variabit, præcipue si magna satis quantitate adhibeantur & longius ebulliant.

A new barometer by the same, n. 385, p. 179. Oel. &c. 1724.

VI. Variis observationibus atque experimentis edoctus gradum caloris aquæ ebullientis variante atmosphæræ gravitate variari, thermometer quoddam excogitavi, quod forsitan si non magis, tamen æque idoneum erit ad explorandam atmosphæræ gravitatem, ac ipsum barometerum.

Fig. 3.

Cylindro A B annectitur tubus B C, cui additur globulus oblongus C D, & huic tubulus gracillimo foramine præditus D E. Cylindrus liquore quodam qui calorem aquæ ebullientis perferre potest replebitur. In tubulo B C gradus caloris in aere obvii mensurabuntur ope scalæ affixæ b c. Si autem thermometer hocce aquæ bullienti immergatur, liquor thermometri non solum globulum C D implebit, sed etiam usque ad terminos varios tubuli D E affurget, secundum gradum caloris quem aqua tempore experimenti a gravitate atmosphæræ

The height of the barometer at different elevations. 19

phæræ acquisitura est. Ita si, e. g. tempore experimenti altitudo mercurii in barometro sit 28 pollicum Londinensium, liquor in hocce thermometro attinget infimum locum in tubulo DE; si vero gravitas atmosphæræ æquipolleat altitudini mercurii pollicum triginta & unius, liquor a calore aquæ ebullientis usque ad locum supremum tubuli DE attolletur; termini varii autem caloris aquæ ebullientis non gradibus denotabuntur, sed numeris digitorum quibus altitudo mercurii in barometris vulgo mensuratur, ope nempe scalæ additæ *de*.

VII. 1. I observed as near as I was able the alteration of the mercury at some small perpendicular elevations which we could measure with a line, and also on the tops of some hills of a moderate height, whose altitude we could observe most commodiously, and by taking the angles large avoid the danger of any considerable refraction.

At the bottom of the tower of Halifax church the mercury stood at 29 inch. 78 dec. At the top it subsided to 29. 66. The height of the place where the observation was made 102 foot.

At the bottom of a coal-mine the mercury stood at 29. 48. At the top it fell to 29. 32. The depth of the mine 140 foot.

At the bottom of another mine the mercury stood at 29. 50. At the top it fell to 29. 23. The depth of this mine was 236 foot.

At the foot of a small hill the mercury stood at 29. 81. At the top it fell to 29. 45. The height of the hill, very exactly measured, was 312 foot.

At the bottom of Halifax hill, commonly called the bank, the mercury stood at 30. 00. At the top it fell to 29. 41. The height of this hill 507 foot.

Mathematicians demonstrate that the density of the air decreases in a geometrical progression as the elevation encreases in an arithmetical one, and consequently that the logarithms of the densities are as the elevations reciprocally. But the weight of the air being as its density, and the height of the mercury in the barometer being always proportional to the air's weight, it follows that the logarithms of the heights of the mercury are reciprocally as the elevations: whence having found by observation what elevation is required to make the mercury stand at any given height, it will be easy to determine how much is requisite to reduce it to any other height proposed. If we make 30 inches (the standard height of the mercury) equal to unity, and suppose an elevation of 85 foot be required to make it fall one tenth of an inch from that height, as by these observations it is very

nearly; then as the logarithm of $\frac{30,0}{29,9}$ is to 85, so is the log. $\frac{30,0}{29,5}$ to the number of feet required to make it fall half an inch, and so of the rest. When the mercury stands above 30 inches the numbers will be negative and shew the spaces descending.

The height of the barometer at different elevations above the surface of the earth. By Dr. Nettleton, n. 388. p. 308 May, &c. 1725.

20. *The height of the barometer*

By this method I computed the following tables, whereof the latter, which contains the differences of the numbers in the former, was of very great use to me when in these experiments the mercury stood at any other height in the tube besides 30 inches, and fell any number of tenths or parts of a tenth, by adding the numbers answering thereto, or proportionable parts of them, to find the elevation required in the table to make the mercury fall so much, and thereby readily to compare therewith the heights found by observation. And though some small errors in the observations make them vary a little from each other, yet in the main they agree as near as possible with the numbers of the table; as did also several other experiments too long to mention, which makes me believe those numbers are not far from the truth.

That the air is colder, as well as more light and rare, in places that are situated high than it is in the vallies and low grounds is generally known; and in order to learn how much it might be so, I got a friend of mine who lives higher than we do here, to observe the portable barometer and thermometer at his house for some days, being placed as near as possible in the same circumstances with mine; and we found his barometer stood at a medium for 20 days 3 tenths lower than mine, and the thermometer 3 deg. 2 tenths lower; allowing for the difference of the instruments which had been observed before.

At another place the barometer, at a medium for 14 days, stood lower by 4. 46. and the thermometer was lower by 4. deg. 4. At another place, which was very high upon the moors, the barometer, at a medium for ten days, stood lower by 0. 65. and the thermometer fell 7°.

A Table

A Table shewing the number of feet ascending, required to make the mercury fall to any given height in the tube, from 30 to 26 inches. As also the number of feet descending, required to make the mercury rise, from 30 to 31 inches.

In. Dec.	Feet.	Dec.	In. Dec.	Feet.	Dec.
31	0834	79	27	9	1847
30	9752	53	27	8	1938
30	8670	01	27	7	2030
30	7587	21	27	6	2122
30	6504	15	27	5	2215
30	5420	82	27	4	2307
30	4337	21	27	3	2401
30	3253	32	27	2	2494
30	2169	10	27	1	2588
30	184	72	27	0	2682
30	000	00	26	9	2776
29	985	00	26	8	2871
29	8170	29	26	7	2966
29	7255	87	26	6	3062
29	6341	73	26	5	3158
29	5427	89	26	4	3254
29	4514	34	26	3	3351
29	3601	08	26	2	3448
29	2688	11	26	1	3545
29	1775	44	26	0	3643
29	0863	08			
28	9951	01			
28	81039	25			
28	71127	80			
28	61216	66			
28	51305	83			
28	41395	32			
28	31485	13			
28	21575	26			
28	11665	70			
28	01756	47			

A Table shewing the number of feet required to make the mercury fall one tenth of an inch from any given height in the tube, from 31 to 26 Inches.

In. Dec.	Feet.	Dec.	In. Dec.	Feet.	Dec.
31	082	26	27	9	31
30	982	53	27	8	31
30	882	79	27	7	32
30	783	06	27	6	32
30	683	33	27	5	32
30	583	61	27	4	33
30	483	89	27	3	33
30	384	16	27	2	33
30	284	44	27	1	34
30	184	72	27	0	34
30	085	00	26	9	34
29	985	29	26	8	35
29	885	58	26	7	35
29	785	86	26	6	35
29	686	16	26	5	36
29	586	45	26	4	36
29	486	74	26	3	36
29	387	03	26	2	37
29	287	33	26	1	37
29	187	63	26	0	38
29	087	93			
28	988	24			
28	888	55			
28	788	86			
28	689	17			
28	589	49			
28	489	81			
28	390	13			
28	290	45			
28	190	76			
28	091	09			

Observations on the barometer,

*...In a silver-
mine. By
And. Celsius.
ibid. p. 313.*

2. In argenti fodina Salana, septem fere milliaribus ab Upsalia versus occidentem diffusa, juxta limen putei reginæ Christinæ, hydrargyri altitudinem 30 digit. & 38 centes. seu $1\frac{11}{16}$ pedis Suecani observavi. Cum barometro deinde in tonna, quæ funi adpensa machinâ hydraulicâ trahitur, ad profunditatem 636 pedum descendimus; ubi mercurius ad 30 dig. 98 centes. ascendisse deprehensus est. Inde iterum erectus ad orificium putei, in eadem ac antea altitudine, nempe 30 dig. 38. cent. columnam mercurialem notavi. Adeo ut hydrargyrum 636 ped. in aëre elatum 6 lineas seu $1\frac{1}{8}$ ped. descenderit; & sic consequenter si aer æque densus ubique supponeretur unius lineæ in cylindro mercuriali variatio 106 ped. altitudini perpendiculari corresponderet. Horæ illius intervallo quo integra perficiebatur observatio cælum erat pluvium nonnihil & ventosum; nulla tamen sensibilis mutatio columnæ mercurialis, in alio barometro supra fodinam parieti affixo, isto tempore videri potuit.

Postero die, aere sereno & tranquillo, ad basin templi urbis Salæ haud procul a fodina distantis argentum vivum 30 dig. 36 cent. altum hæsit, ad altitudinem vero 145 ped. in turri ejusdem templi scandens mercurium ad 30 dig. 23 cent. substituisse deprehendi, ut unius lineæ in barometro descensui altitudo $111\frac{1}{3}$ ped. respondeat. Basis templi 60 fere pedes infra superficiem fodinæ deprimitur. Ipsius autem fodinæ elevationem supra mare Balticum explorare nondum licuit.

Ut hæc nostra observatio cum exterorum hujus generis experimentis rite conferri queat, notandum est inter pedem Suecanum & Parisinum regium eam rationem intercedere quæ est inter 1000 & 1096, seu 125 & 137 proxime; quam ex pede Gallico orichalceo, insignis artificis Chapotot manu inculpto, cum pede Stiernhielmiano qui in bibliotheca publica Upsal. servatur collato, exactissime observavi.

*An extraordinary height
of the barometer. By Mr.
G. Graham,
n. 369. p. 222
Sept. &c.
1721.*

3. On Dec. 21. 1721. observing the barometer much higher than usual, that evening between seven and eight a clock I filled a tube with very clean quick-silver, and found the height a little to exceed 30. $7\frac{1}{2}$ inches. By eight the next morning a wheel-barometer which hung in the same room had risen one tenth of an inch higher than it was the night before, when the experiment was made; at ten a clock one fifth of an inch more: at which time it was at the highest, being a little above 30. $8\frac{1}{2}$ inches; for about twelve at noon it was sensibly lower and continued falling all the rest of the day.

When the lower end of the tube was first immersed in the cistern, the quick-silver for some time adhered to the crown of the glass, but, upon shaking, it fell to the height above-mentioned.

BAROME-

BAROMETRUM.	THERMOM.	HYGROMETR.	
Hic pono pondus atmosphære incumben- tis in planum pedis quadrati Rhenolandi- ci, cujus atmos. pon- dus 1947 libras Am- stelædamenses pendet, quando $\frac{3}{4}$ in barome- tro altitudo est 27 poll. 7 lin. pendet 2094 lb. Amst. quando altitudo $\frac{3}{4}$ in barometro est 29 poll. 8 lin. hæc enim fuit maxima & mini- ma $\frac{3}{4}$ in barometro observata altitudo in- tra plures jam annos.*	Hic calorem at- mosphære in lo- co observationis destinavi ex ra- rescente aere ita ut summum fri- gus observatum sit ubi notabatur gradus 1000, a- qua pura gelaf- ceret ad grad. 1070, ebulliret vero ad grad. 1510.	Mensuravi hic a- quæ copiam in at- mosphæra in loco observationis; juxta accrescens decrescen- sive pondus spongiæ ad bilancem appen- sæ, quam spongiam prius muria salis am- moniaci humectave- ram.	Quantitas aquæ, quæ totius hu- jus anni decurfu mense quo- libet ex- halaverat in aere a- perto & ventis per- flato. Rhe- noburgi.
lb.	grad.	pond.	lin.
Januar. - - - 2051	- - - 1076	- - - 81	- - 7
Februar. - - - 46	- - - 85	- - - 80	- - 14
Martio - - - 35	- - - 102	- - - 80	- - 33
Aprili - - - 46	- - - 109	- - - 60	- - 36
Maio - - - 57	- - - 126	- - - 57	- - 58
Junio - - - 53	- - - 140	- - - 57	- - 57
Julio - - - 2044	- - - 129	- - - 58	- - 37
Augusto - - - 46	- - - 141	- - - 60	- - 39
Septemb. - - - 54	- - - 132	- - - 61	- - 24
Octobri - - - 55	- - - 121	- - - 71	- - 15
Novemb. - - - 53	- - - 104	- - - 77	- - 15
Decemb. - - - 35	- - - 96	- - - 79	- - 12
Summa 578	1268	822	347
xx			
Medium 2048	1113	68	toto anno. 28 pol. 11 lin.

Observations
in different
places of the
barometer,
thermometer,
hygrometer,
the weather,
etc. in 1723.
By N. Cru-
quius, n. 381
p. 4. Jan.
&c. 1724.

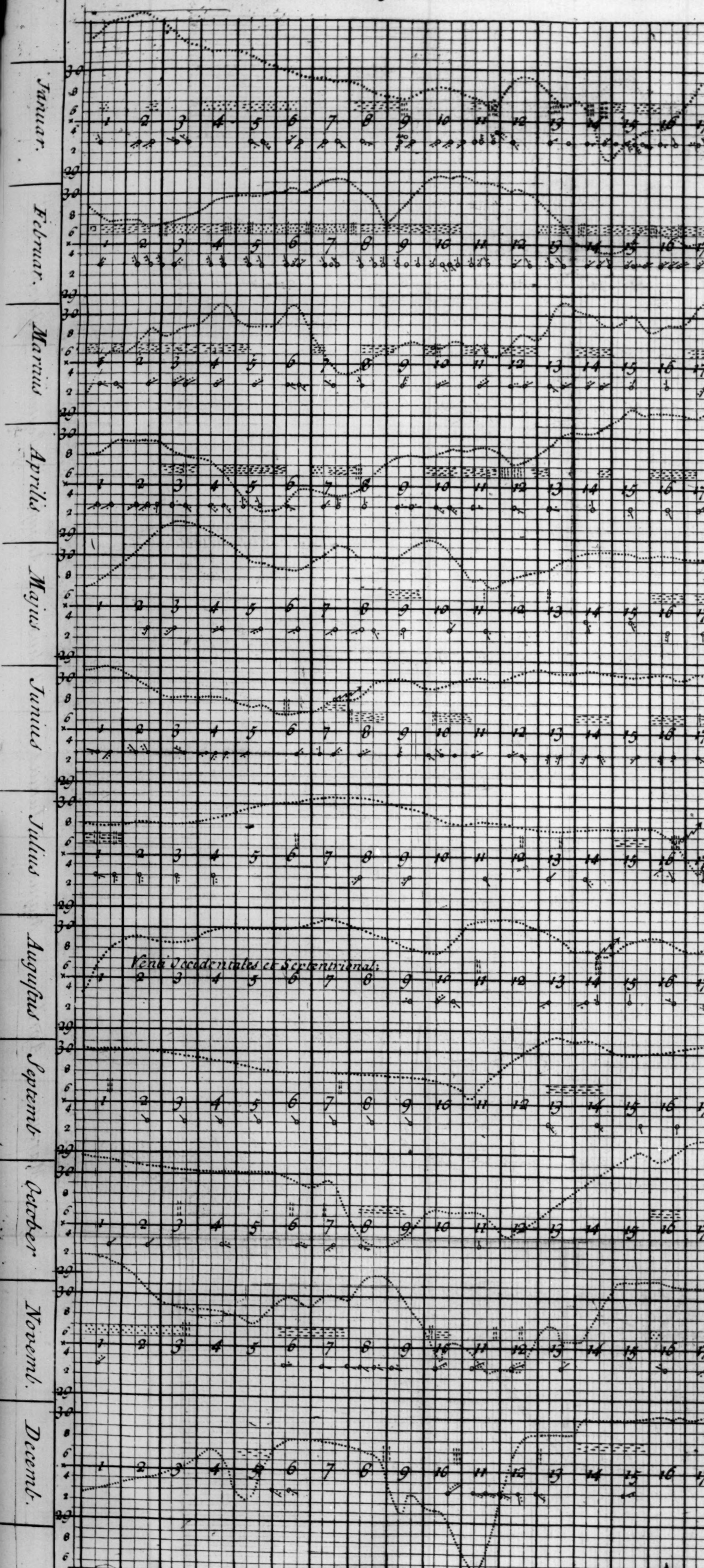
* Vid. place
II.

Aquæ cœlo delapsæ, nimirum Pluviæ, roris, Nivis, grandinisque altitudo ; Cum cauta cura, ne exhalatione, aut alio modo vel minimum perierit.		Aquæ altitudo putealis, in puteo, mensurata a summo ejus margine ad aquæ superficiem in fine cujusque mensis. Fuit vero putei profunditas imasque ad fabulum scaturiens vel currens, & nihil aquæ inde eductum toto observationis tempore.		Observatio accelerati, vel retardati cursus, in horologio portatili accuratissimo. Ut pateat quot minuta, in quoque mense, plura vel pauciora, absolverit, hic (+) augmenti, (−) decrementi nota est. Ratio relata ad folis decursum.	
Delphis.	Rhenoburgi.				
lin. dec.	lin. dec.		ped. pol.		Minuta.
- - 17.9	- - 21.2	- - 5 : 4	- - + 151	Jan.	
- - 25.1	- - 23.8	- - 4 : 11	- - + 21	Febr.	
- - 18.8	- - 28.-	- - 5 : 7	- - ÷ 168	Mar.	
- - 5.5	- - 7.5	- - 6 : 10	- - ÷ 120	Apr.	
- - 4.2	- - 2.7	- - 8 : 1	- - ÷ 123	Maio.	
- - 3.2	- - 4.8	- - 9 : 3	- - ÷ 130	Jun.	
- - 38.6	- - 28.-	- - 9 : 7	- - ÷ 90	Jul.	
- - 41.9	- - 40.2	- - 9 : 7	- - + 133	Aug.	
- - 15.1	- - 14.8	- - 9 : 9	- - + 24	Sept.	
- - 8.2	- - 11.3	- - 9 : 8	- - + 19	Oct.	
- - 30.7	- - 29.7	- - 9 : 3	- - + 266	Nov.	
- - 30.6	- - 40.-	- - 8 : 2	- - + 252	Dec.	
- - 2398.	- - 252	- - 96 : ---	+ 866, & ÷ 631		
			five + 235		
poll. 20 (in toto anno) 21 poll.		Med. 8 ped.		in quoq; mens. 20' accelerat.	

thermometer, hygrometer, and the weather.

Ann.	Jan.	Feb.	Mart.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Sum.	Med.	Ann.
	lb.												12	lb.	
1720	2034	34	38	36	38	42	45	36	50	40	38	23	454	2038	1720
1721	52	42	36	29	29	43	51	46	43	42	32	29	474	39	1721
1722	76	41	32	41	42	45	36	39	50	59	37	30	528	44	1722
1723	51	46	35	46	57	53	44	46	54	55	53	35	573	48	1723
4	2033	2033	2041	2052	2068	2082	2096	2107	2117	2088	2068	2057	2068	2068	
2053	41	35	38	38	41	46	44	42	49	49	40	29	2042	2042	
	grad.														
1720	2087	89	86	102	126	126	145	138	121	107	91	91	2088	109	1720
1721	90	74	75	112	116	137	136	142	133	110	100	84	2088	109	1721
1722	79	90	97	109	122	134	139	140	135	117	101	90	2088	113	1722
1723	76	85	102	109	126	140	129	141	132	121	104	96	2088	113	1723
4	2032	2038	2060	2072	2088	2107	2121	2137	2154	2137	2107	2088	2137	2137	
83	85	90	108	122	134	140	137	140	130	114	99	90	2137	2137	
	pond.														
1721	89	82	73	80	69	64	63	68	76	76	89	88	882	76	1721
1722	88	85	76	63	62	62	63	68	70	76	81	88	882	74	1722
1723	81	80	80	60	57	57	58	60	61	71	77	79	822	69	1723
2	2058	2047	2029	2013	2008	2002	2004	2006	2007	2023	2047	2058	2058	2058	
86	82	76	68	63	61	61	61	65	69	74	82	85	73	73	
	linex														
1715	11	20	36	8	15	18	95	62	36	37	47	15	400	33	1715
1716	19	20	14	7	17	4	48	19	55	57	21	32	323	26	1716
1717	31	15	29	29	31	28	29	28	24	32	29	28	323	27	1717
1718	21	18	6	30	17	17	35	27	14	46	21	25	277	23	1718
1719	33	20	10	11	17	4	12	34	23	25	24	22	235	19	1719
1720	36	24	21	21	15	20	23	55	47	56	25	20	363	30	1720
1721	20	31	27	59	30	34	15	41	27	57	30	48	428	34	1721
1722	2	20	25	23	15	22	49	53	25	7	21	53	325	26	1722
1723	18	25	19	5	4	3	39	42	15	8	31	31	240	20	1723
2	2058	2047	2029	2013	2008	2002	2004	2006	2007	2023	2047	2058	2058	2058	
21	21	21	21	21	18	17	38	40	30	36	28	30	242	26	10

IX. Tabula, praecipue Altitudinem fere Singulis Horis BARO
 Londinensib; ut et ^{pro}parie Pluvias; Plagas, Violentiasque Ventorum; nec no



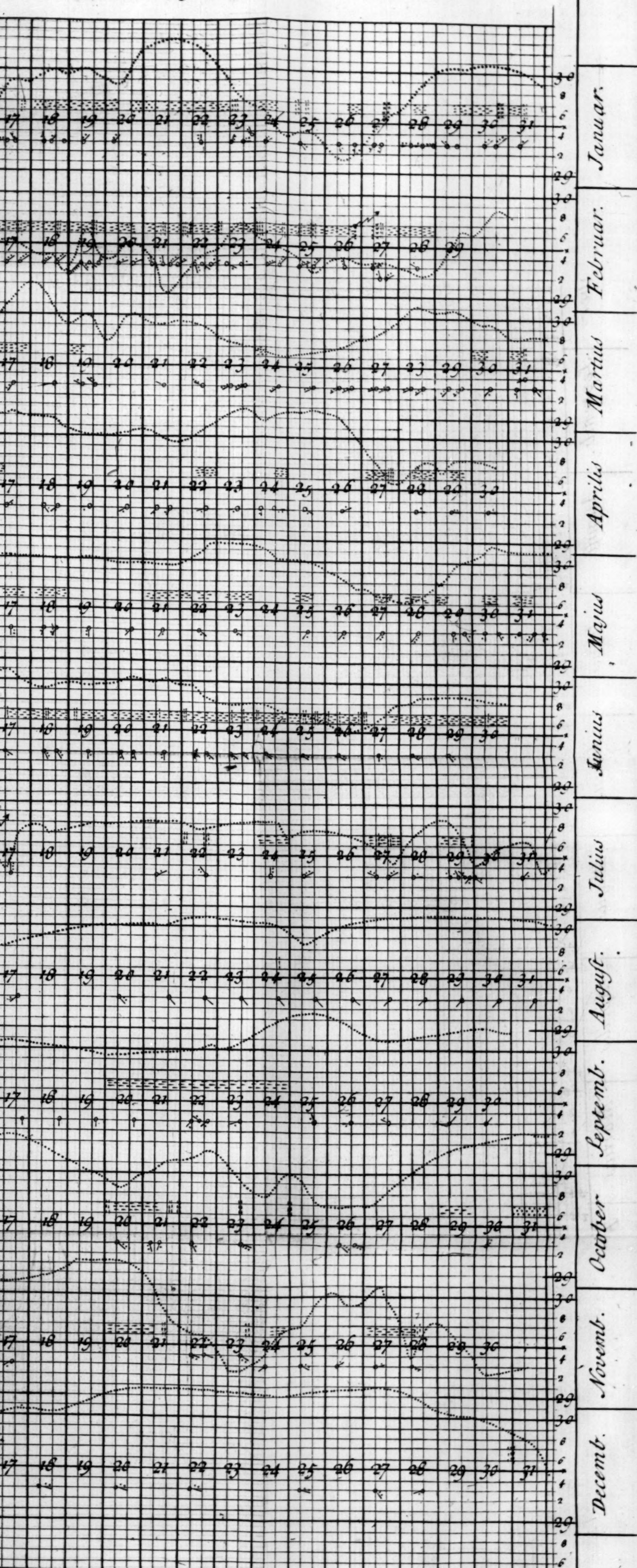
Altitudo Barometri. Velum. Vires Ventorum. Pluvia. Nix.

Explicatio



Facing page 26 Vol. I Part II.

OMETRI, totius Anni decursu 1725 Stylo Veteri. digitis
 non Coeli faciem, Lugduni Observata exhibens.



gnorum
 Grando. Nebula. Tonitru. Coelum Nubibus Obductum

Meteorological observations.

27

X. In tempore connotando diei cujusque initium a meridie, ut astronomi consuevere, supputavi.

Veteri autem stylo in temporibus designandis, et in mensuris anglico pede ejusque partibus usus sum.

Nivem liquefieri curavi; liquatamque ratione eadem ac pluviam aquam metitus sum.

Barometri mei tubulus satis amplus est, et vasis quo stagnans mercurius continetur diameter est ferme vigecupla diametri tubuli: quamobrem ascendente intra eundem tubulum et descendente mercurio, altitudo mercurij eo in vase tuto potest ceu invariata reputari.

Thermometrum meum ex genere illorum est, quorum inventio Amontonio tribuitur. Tubulus est recurvus desinens in phialam, cujus pars inferior vivo argento, superior aere repletur; hujusque dilatatione vel majore vel minore, pro varia caloris vi, mercurius in tubulo vel magis vel minus attollitur. Quoniam vero tubuli extremitas patula est, idcirco oportuit veram thermometri altitudinem ex altitudine mercurij observatâ in thermometri tubulo, altitudineque mercurij in barometro, collectis in unam summam, componere; inque ephemerides referre altitudinem eadem plane ratione compositam. Est autem thermometrum meum appensum ad parietem cubiculi (in quo vix unquam ignis accenditur) facie unâ ad meridiem, alterâ ad orientem solem obversâ: neque enim aptum locum ad septentriones respicientem habeo. Thermometri mei phialâ intra glaciem immersâ subsidit mercurius ad dig. 47. dec. 30. intra ebullientem aquam ascendit dig. 63. dec. 10. Porro iisdem semper instrumentis et ad eandem jugiter plagam constitutis usus sum.

Ventorum directiones singulis diebus adscripsi; eorum autem vires dumtaxat cum satis potentes, majores, vel maximae fuere, numeris 2, aut 3, aut 4, pro magnitudine eorum signavi; praetermissis zero, sive malaciae signo, et unitate, venti lenissimi indicio.

Ut aquae pluviae, nec non ex fusa nive collectae, quantitates (ut ferunt summae ex observationibus desumptae, singulis mensibus convenientes) considerari queant; eas in subjectam tabellam conjeci.

Six years meteorological observations made at Padua, By the Marquis Poleni, n. 421, p. 201. Oct. &c. 1731.

D 2

JAN.

Meteorological observations.

	1725.		1726.		1727.		1728.		1729.		1730.	
	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.
JAN.	0	521	1	355	5	955	4	278	1	085	0	112
FEB.			1	460	1	073	1	050	1	245	2	906
MAR.	0	889	3	168	1	878	4	832	2	902	4	592
APR.	4	019	3	998	0	498	1	419	2	768	1	638
MAY.	3	625	1	368	3	530	3	403	2	634	4	467
JUN.	0	036	2	608	2	476	2	103	3	134	6	205
JUL.	2	297	2	357	2	930	4	016	4	526	2	339
AUG.	5	185	1	268	5	067	5	186	0	578	4	269
SEP.	2	647	2	900	4	164	6	948	3	267	1	090
OCT.	7	104	0	179	6	576	5	163	6	294	5	254
NOV.	3	636	2	277	5	091	6	836	4	186	0	534
DEC.	0	030	2	390	7	169	7	599	2	804	0	894
Summa totius anni.	29	989	25	328	46	407	52	833	35	423	34	300

Si iidem menses illorum sex annorum colligantur in unam summam, comperietur ex tabellâ minimam aquae quantitatem decidisse mensibus Februariis; quippe quae non excesserit dig. 7. dec. 734. Maximam vero Octobribus mensibus, quae dig. 30. Dec. 570, aequaverit. Praeterea ex tabellâ eâdem facile apparet ficciolem annis aliis fuisse annum 1726, qui dedit aquae dig. 25. dec. 328: aliis autem annis humidiorum fuisse annum 1728, quo collegi aquae dig. 52. dec. 833.

Numeros praeterea quantitatum aquae quae singulis anni tempestatibus decedit seorsum collegi; tempestates ita partiens ut hyemis initium referrem ad decimam diem Decembris anni praecedentis, et sic porro ad diem decimam Martij, Junij, atque Septembris tempestatum reliquarum initia constituerem.

	Hyems.		Ver.		Aestas.		Autumnus.	
	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.
1725	0	912	8	167	7	584	13	327
1726	2	815	9	6	7	355	4	999
1727	8	181	5	916	11	875	15	497
1728	11	419	10	752	12	83	20	556
1729	7	470	9	430	6	310	13	617
1730	8	693	8	817	12	818	6	562
Sum.	39	490	52	88	58	25	74	558

Hinc

Hinc patet quantitatem aquae pertinentis ad aestatem et autumnum singulis annis majorem fuisse quantitate aquae pertinentis ad hyemem et ver.

Si quantitates ad quamlibet tempestatem pertinentes colligantur in unam summam et hae summae conferantur inter se, incrementa progrediuntur eodem ordine ac tempestates, ordiendo ab hyeme; hoc est; quantitas aquae minima hyemis tempore cadit, tempore veris major, haec vero superatur ab aestatis tempore, autumnali demum tempore maxima reperitur.

Notum autem est pluviam a decreſcente, serenitatem vero a crescente barometri altitudine indicari. Ut igitur explorarem quantum valeant indicia illa, dies quibus pluit sex illis propositis annis collegi in varias summas pro ventorum varietate, atque pro incremento aut decremento altitudinis barometri.

Decreſcente barometro.

Crescente barometro.

A meridie diei praecedentis ad meridiem diei quo pluit:

Numerus dierum quibus pluit.	Ventus meridie illorum dierum.	Numerus dierum quibus pluit.	Ventus meridie illorum dierum.
86	N.	64	N.
61	N E.	41	N E.
33.	E.	16	E.
28	S E.	17	S E.
44	S.	21	S.
42	S W.	15	S W.
49	W.	20	W.
35	N W.	17	N W.
378	Summa.	211	Summa.

Hac absolutâ tabellâ, miratus profecto sum inter numeros incrementi decrementique altitudinis barometri non majorem differentiam interesse quam ea quae inter 378 et 211 intercedit. Fateor equidem aliquoties crescente barometri altitudine a praecedente meridie ad meridiem diei quo pluit, coepisse tamen altitudinem eam decreſcere post meridiem diei ejusdem quo pluuisse contigit: praeterea vero incrementum illud aliquoties sumi posse tanquam indicium futurae, post haud longam pluviam, serenitatis: rationem etiam quantitatis pluviae esse habendam. Saepe tamen nulla ex hisce excusatio praesto esse potest ut servetur constantia legis qua sancitur, decrementsa altitudinis barometri esse pluviae, incrementa vero serenitatis indicia.

Nivalium postea dierum propositis sex illis annis contentorum comparisonem institui superioris illius similem; unde animadverti quod nix magis quam pluvia barometri decrementis respondeat.

Decreſcente

Meteorological observations.

Decrescente barometro, Crescente barometro,

A meridie diei praecedentis ad meridiem diei quo nixit.

Numerus dierum quibus nixit.	Ventus meridie illorum dierum.	Numerus dierum quibus nixit.	Ventus meridie illorum dierum.
4	N.	4	N.
6	N E.		
1	E.		
1	S W.		
1	W.		
1	N W.		
14	Summa.	4	Summa.

Praeterea vero pro singulis annis summas altitudinum barometri ac thermometri confeci ; ex quibus deinde altitudines medias elicui.

	Summa altitu- dinum barometri.		Summa altitu- dinum thermometri.		Altitudo me- dia barometri.		Altitudo me- dia thermometri.	
	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.
1725	10854	26	18287	66	29	74	50	10
1726	10823	8	18268	93	29	65	50	5
1727	10831	17	18325	96	29	67	50	21
1728	10864	72	18419	81	29	68	50	33
1729	10842	23	18326	62	29	70	50	21
1730	10853	75	18264	18	29	74	50	4

Porro si altitudines barometri omnium sex annorum in unam sum-
mam colligantur, invenietur media ejus altitudo dig. 29. dec. 70.

Si thermometri altitudines sex annorum omnium colligantur in unam
summam, comperietur media illius altitudo dig. 50. dec. 16.

Unde patet medias altitudines tum barometri tum thermometri per-
tinentes ad annos singulos, paucissimis partibus differre a mediis altitu-
dinibus quae ex sex illis annis collectim sumtis proficiuntur.

Maximas deinde barometri et thermometri altitudines minimasque
in sequentem tabellam redegi, ut uno aspectu inter sese possent com-
parari.

Ann

Meteorological observations.

31

Anni	Menses.	Dies S. V.	Hora h.	Maxima baromet. altit.		Minima barome- tri altit.		Ther- mome- tri altit.		Venti.	Tempestas.
				Dig.	Dec.	Dig.	Dec.	Dig.	Dec.		
1725	JAN.	19	15	30	28			48	45	W.	Coelum sudum.
	DEC.	8	4	15		28	56	47	98	SW. 4.	Coelum nubibus fere obductum.
1726	NOV.	28	45	30	18			48	70	N.	Coelum sudum.
	FEB.	13	15			28	92	48	62	SW.	Coelum nubibus fere obductum.
1727	NOV.	20	15	30	24			48	88	N W.	Coelum sudum.
	OCT.	29	3			28	80	49	6	S. 2.	Coelum nubibus obductum.
1728	DEC.	2	15	30	20			48	98	N.	Nubes raræ.
	DEC.	12	15			29		48	60	N.W.	Pluvia tenuis.
1729	DEC.	20	15	30	30			48	88	W.	Coelum nubibus fere obductum.
	NOV.	10	15			28	90	49	30	N.	Pluvia.
1730	DEC.	20	15	30	40			48	20	N.	Coelum sudum.
	FEB.	27	15			28	98	48	78	S E.	Sol et nubes alternatim.
				Baro- metri altit.		Maxi- ma ther. altit.		Mini- ma ther. altit.			
				Dig.	Dec.	Dig.	Dec.	Dig.	Dec.		
1725	JUL.	9	15	29	64	52	50			S. 2.	Coelum sudum.
	DEC.	23	15	29	25			47	82	N E.	Sol et nubes alternatim.
1726	JUL.	15	15	29	74	52	40			S.	Coelum sudum.
	JAN.	14	15	29	68			47	68	W.	Coelum nubibus fere obductum.
1727	JUL.	13	15	29	60	52	18			E.	Sol paucaeque nubes.
	JAN.	2	15	29	68			48	15	S E.	Aer nebulosus.
1728	JUN.	22	15	29	68	52	54			S.	Sol paucaeque nubes.
	DEC.	26	15	29	30			48	8	N. 2.	Coelum nubibus fere obductum.
1729	JUN.	25	15	29	70	52	28			N E.	Coelum sudum.
	JAN.	14	15	29	50			47	82	S W.	Coelum sudum.
1730	AUG.	4	15	29	76	52	28			N.	Sol et nubes alternatim.
	DEC.	23	15	30	30			47	58	W.	Coelum sudum.

Uc.

Meteorological observations.

Ut vero pluviae quantitates conferri possint cum quantitatibus his quae in regiae scientiarum academiae commentariis reperiuntur, mensuras Anglicas in Gallicas transtuli, illas ad regium Parisiensem pedem (in pollices atque lineas divisum) referendo, ac summas ad annum quemlibet novo stilo computatum confeci.

Anni Stilo Novo.	Pol. & lin. ped. Paris.
1725	28 $1\frac{1}{2}$
1726	23 $2\frac{1}{2}$
1727	42 11
1728	49 $9\frac{1}{2}$
1729	34 $1\frac{3}{4}$
1730	32 $1\frac{1}{8}$
Summa.	210 $3\frac{1}{2}$

Quare si pol. 210. et lin. $3\frac{1}{2}$. dividantur in annos sex, mensura media quantitatis aquae pluviae conveniens singulis annis prodit pol. 35. lin. $\frac{1}{2}$. mensura autem media aquae quae cadit Lutetiae Parisiorum (ut habetur in academiae commentariis an. 1711, 1714, 1715, et alibi) pro uno anno pollicum 19 esse computatur. Quamobrem Patavina media mensura mediam Parisiensem excedit pollicibus 16. lin. $\frac{1}{2}$. Aut, si assumamus pro mediâ mensurâ Parisiensi pol. 18. lin. 8. (quemadmodum ex observationibus triennio habitis colligitur in commentariis an. 1719) erit differentia pol. 16. lin. $4\frac{1}{2}$. Itaque plane liquet aquae copiam hic decidere multo maiorem quam Lutetiae Parisiorum.

A meridie diei 23. (ST. V.) Augusti anni 1727. (vento boreali) ad meridiem sequentis diei, nimirum intra horas 24, decidit pluviae pol. 3. lin. $\frac{1}{2}$. hoc est lin. $36\frac{1}{2}$. Quae sane pluviae copia multo major est eâ quae intra horas 24 unquam deciderit Lutetiae Parisiorum.

Si maxima barometri altitudo die 20. Dec. 1730. hic observata redigatur ad Gallicam mensuram, comperietur esse pollicum 28 lin. 6. minima vero barometri altitudo, die sc. 8 Dec. 1725. inveniatur pollicum 26. lin. $9\frac{1}{4}$. Quamobrem mercurij in barometro differentia inter maximam altitudinem minimamque colligetur pollicum 1. lin. $8\frac{1}{4}$.

Assumto itidem sexennio observationum, quas in regio observatorio habuit Lutetiae Parisiorum Philippus Hirijs (nimirum ab anno 1699 ad annum 1705) inveni maximam barometri altitudinem die 10. Dec. 1704. pol. 28. lin. $4\frac{1}{2}$. Minimam vero die 20 Dec. 1703. pol. 26. lin. 5: atque ideo mercurij in barometro differentiam inter maximam altitudinem minimamque fuisse pol. 1. lin. $11\frac{1}{2}$. Differentia itaque inter maximam atque minimam mercurij in barometro altitudinem Lutetiae Parisiorum inventa fuit major quam Patavij lin. 2 $\frac{1}{2}$. Et quidem jamdudum

dum nonnulli fuerē qui observarent, illiusmodi differentias eo minores reperiri, quo magis loca in quibus observationes instituuntur sunt aequatori circulo vicina.

XI. Dr. Niewentyt † and some others say, that particles of fire separated from the sun-beams, by adhering to particles of water make up molecularæ, or small bodies, specifically lighter than air, which therefore, by hydrostatical laws, must rise and form clouds that remain suspended when they come to such an height that the air about them is of the same specific gravity with themselves. And

Of the rise of vapours, formation of clouds, and descent of rain. By Dr. J. T. Desaguliers, n. 407. p. 6. Jan. &c. 1729.

That rain is produced by the separation of the particles of fire from those of water, which last being then restored to their former specific gravity can no longer be sustained by the air, but must fall in drops.

But 1. This supposes that fire is a particular substance or distinct element, which the Rev^d. Mr. Hales has * shewn to be an ill grounded opinion; making it very plain, that in chymical operations those bodies which were thought to become heavier by particles of fire adhering to them, become so by the adhesion of particles of air, &c.

2. Though the supposition should be granted, the difficulty would still remain. Dr. Niewentyt ascribes rain to two different causes. First, to condensation, saying, "That when contrary winds blow against the same cloud and drive the watery particles together, the fire that adhered to them gets loose, and they becoming then specifically heavier precipitate and fall down in rain." Then in the very next Section he ascribes it to rarefaction, when he says, "That when a wind blowing obliquely upwards, causes a cloud to rise into a thinner air (i. e. specifically lighter than it self) the fire which by sticking to the particles of water rendered them lighter, extricates it self from them, and ascending by its lightness, the water will become too heavy, not only to remain in this thin and light air, but even in a thicker and heavier near the earth, and so will be turned into a descending dew, mist, or rain, or snow, or the like, according as the watery vapours are either rarefied or compressed."

The first of these causes of rain is contrary to experience; for when two contrary winds blow against each other over any place of the earth, the barometer always rises and we have fair weather. For then, as Dr. Halley says, in the Phil. Trans. n. 181. ‡ the air being accumulated above, becomes specifically heavier about the clouds, which (instead of falling into rain, as Dr. Niewentyt supposes) ascend up into such a part of the atmosphere, as has the air of the same specific gravity with themselves.

‡ Vol. II. C. I. §. ix, x.

† Religious Philosopher. Contemp. 19. § xiii. to xxv.

* Vegetable Statics.

Of the rise of vapours, formation of clouds,

If the falling of rain might be attributed to the second of these causes, then every time a cloud is encompassed with air specifically lighter than it self rain must necessarily follow; whereas one may often see the clouds rise and fall without rain, even when the barometer shews the weight of the air to be altered. For rain happens only when by the great diminution of the specific gravity of the air about the cloud, it falls a great way and the resistance of the air, which encreases as the square of the velocity of the descending cloud, forces the floating particles of water within the power of each others attraction, and forms such big drops as being specifically heavier than any air must fall in rain.

No gentle descent of a cloud, but only an accelerated motion downwards produces rain: not that the quick descent of a cloud is the only cause of rain; for the shock of a flash of lightning, and the sudden return of the air after the vacuum made by the flash, will condense the floating vapour into water; and a cloud which in the free air might be carried horizontally without being turned into rain, meeting with an high hill in its way, will be condensed and fall into drops; especially if, in the day-time, it be driven by the wind out of the sun-shine, against the shaded side of the mountain.

If particles of fire raised up those of water they must be at least 1000 times greater in bulk than the watry ones; so that a person who at the top of a hill has his hands and face in a cloud must feel a very sensible warmth, by touching a much greater surface of fire than water in the cloud, and afterwards find the rain produced from that vapour sensibly colder; whereas the contrary is proved by our senses; the tops of hills, though in the clouds, being much colder than the rain at bottom.

Another opinion is, that though water be specifically heavier than air, yet if its surface be encreased by very much diminishing the bulk of its particles, when once raised it cannot easily fall; because the weight of each particle diminishes as the cube root of its diameter, and the surface to which the air resists only as the square root of the said diameter: that we see this in the dust in summer, and in menstruums that sustain dissolved metals specifically heavier than themselves.

But though the encrease of surface will in a great measure retard the descent of small bodies in the air, it will for the same reason also hinder their ascent. The rise of dust is owing to the motion of animals, or to the wind: whereas vapours rise in calm weather, as well as windy; neither do they, like the dust, always fall to the ground when the wind ceases to blow.

The opinion most commonly received is, that by the action of the sun on the water, small particles thereof are formed into hollow spheres filled with a finer air highly rarefied, so as to become specifically lighter than common air.

To give this solution all its force ; let A represent a particle of air, and W one of water of equal bulk, then will the weight of A be to the weight of W as 1 to 850. If the particle of water be blown up into a bubble (*w*) of 20 times its diameter, then will its bulk be to its weight, as 8000 to 850, whilst a sphere of air (*a*) of the same bigness, has its weight as well as bulk equal to 8000. Now if air $\frac{1}{4}$ rarer than common air be supposed within the watry bubble to keep it blown, it will be the same as if $\frac{1}{4}$ of the air of *a* was carried into *w*, and then the weight of *w* would be encreased by the number 6000 ; so that the shell of water being in bulk 8000, would be in weight $850 + 6000 = 6850$, whilst an equal bulk of air weighed 8000, and consequently the watry bubble would rise till it came to an air, whose density is to the density of the air next to the surface of the exhaling water as 6850 to 8000. This is the strongest way of stating the hypothesis. But to support it, the following queries must be answered.

1. How comes the air in the bubbles to be specifically lighter than the air without them, since the sun's rays which act upon the water are equally dense all over its surface ?

2. If a rarer air could be separated from the denser ambient air to blow up the bubbles, what would hinder that cold air from reducing the bubbles by its greater pressure to a less bulk, and so to a greater specific gravity than the air ?

3. If clouds are made up of hollow shells of water filled with air, why do not those clouds always expand when the ambient air is rarefied and presses less than it did before, and also suffer a condensation as the ambient air is condensed by the accumulation of the superior air ? and if this condensation and rarefaction should happen to the clouds, they would always continue at the same height, and we should never have any rain. Therefore the condensation and rarefaction of the vapours which make clouds must depend upon another principle than the condensation and rarefaction of the air : and that there is such a principle I shall endeavour to shew.

LEMMA.] The particles of all fluids have a repellent force. Fluids are elastic or unelastic : The elastic fluids have their density proportionable to their compression, and † consist of parts that repel each other. Unelastic fluids, like mercury, water and other liquors, are by experiments found to be incompressible. Now this property of water and other liquors must be owing to the centrifugal force of its parts, and not to its want of vacuity ; since salts are imbibed by water without encreasing its bulk, as appears by the encrease of its specific gravity. So metals singly have a certain specific gravity beyond which they cannot be condensed, yet receive each other in their interstices so as to make a compound specifically heavier than the heaviest of them ; as appears in the mixture of copper and tin.

† Newt. *Prin. lib. ii. §. v.*

Of the rise of vapours, formation of clouds,

SCHOL.] By encreasing the repellent force of the particles, an unelastic or incompressible fluid may become elastic, or a solid, at least a great part of it, may be changed into an elastic fluid; and by diminishing the repellent force, an elastic fluid may be reduced to an unelastic fluid, or to a solid. The particles of quicksilver, water and other liquors have also an attractive force, for they run into drops in an exhausted receiver as well as in the air, and adhere to other bodies. Attraction and repulsion exert their forces differently: attraction only acts upon the particles which are in contact, or very near it; in which case it overcomes the repulsion so far as to render that fluid unelastic which otherwise would be so; but it does not wholly destroy the repulsion of the parts of the fluid, because on account of that repulsion the fluid is then incompressible. When by heat or fermentation, or any other cause, the particles are separated from their contact, the repulsion grows stronger, and the particles exert it at greater distances, so that the body is expanded into a very large space by becoming fluid, and sometimes takes up above a million of times more room than it did in a solid or incompressible fluid. Thus is water changed by heat into an elastic vapour rare enough to rise in air.

That heat will add elasticity to fluids is evident from numberless experiments. But it acts much more powerfully on water than common air; for the same heat which rarefies air only $\frac{1}{3}$ rarefies water very near 14000 times, changing it into steam or vapour: and that small degree of heat which in winter appears cold to our bodies raises a vapour from water at the same time that it condenses air.

By a great many observations made by Mr. H. Beighton and myself upon the engine to raise water by fire according to Mr. Newcomen's improvement of it, water in boiling is expanded 14000 times to generate a steam as elastic as common air, which therefore must be near $16\frac{1}{2}$ times specifically lighter. And that this steam is not made of the air extricated out of the water is plain, because it is condensed again into water by a jet of cold water spouting in it; and the small quantity of air that comes out of the injected water must be discharged at every stroke, otherwise the engine will not work well. This is confirmed by the following experiment.

Fig. 5.

ABCD is a vessel of water set upon the fire to boil. In it is suspended the glass bell E made heavy enough to sink, being first filled with water when upright, without any bubbles of air at its crown within. As the water boils the bell is by degrees emptied of its water, which is pressed down by the steam that rises above it in the bell. Now, in order to know whether that steam be air or not, take the vessel off the fire and draw up the bell till the mouth only remains under water; then, as the steam within the bell condenses by the cold
air

air on the outside, the water will rise up into the bell at F quite to the top, without any bubble above it ; which shews that the steam which kept out the water was not air. This succeeds best when the water has been first purged of air by boiling, and the air-pump.

We know by several experiments made on the fire-engine (in Captain Savery's way, where the steam is made to press immediately on the water) that steam will drive away air, and that in proportion to its heat ; though in the open air it floats and rises in it like smoke.

Now if the particles of water turned into steam or vapour repel each other strongly, and repel air more than they repel each other ; aggregates of such particles made up of vapour and vacuity may rise in air of different densities, according to their own density.

To apply this ; the heat of boiling water, according to Sir I. Newton's table † in the Phil. Trans. n. 270. is 34, the mean heat of summer 5, the mean heat of spring or autumn 3, and the mean heat of winter by which vapours rise is 2. The rarity of vapour proportionable to these four degrees of heat, is 14000, 2058, 1235, and 823. The rarity of air is, in summer 900, in spring or autumn 850, and in winter 800, the density of water compared with the above-mentioned densities, being inversely as one to the said fore-mentioned four numbers. The heights above the earth at which the vapours will be in æquilibrium in an air of the same density with themselves, will vary according to the heat of the season. The vapour which is raised by the winter's heat when the air's rarity is 800, will settle at an height of about the sixth of a mile, when the barometer is above 30 inches high. If the heat be greater they will rise higher, and pretty much higher if the sun shines, though in frosty weather, the barometer being then very high. If the barometer falls, and thereby brings the place of æquilibrium (for vapours raised by the heat 2) nearer the earth, then also will the heat be increased, the vapour more rarefied, and consequently the new place of æquilibrium sufficiently high. In winter, when the heat is only 2, the air is densest close to the earth, which has not heat sufficient to rarefy it near the ground as in warm weather ; therefore the vapour will rise gradually in an air whose density decreases continually from the earth upwards ; neither will it be hindered by the cold of the ambient air, which is as cold next to the ground where the vapour begins to rise, as it is at any height from the earth.

The vapour raised by the heat of spring or autumn expressed by number 3, will rise to the height of $3\frac{1}{2}$ miles, when the barometer is at 30, and the air's rarity 850. But as the air is hotter near the ground than at any height, the vapour will condense as it rises ; and as the air, when the earth is heated, is rarer near the ground than at some height from it, the place of æquilibrium for vapour will, upon these two ac-

counts

† Vol. IV.
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§. 1.

counts, be brought much lower than otherwise it would be ; as for example, to the height of about a mile, which will agree with phænomena.

In summer, the two causes above-mentioned encreasing, the vapour raised by the heat 5 (whose place of æquilibrium would be $5\frac{1}{2}$ miles high, if the vapour after it began to rise was not condensed by cooling, and the air was densest close to the earth) will settle at the height of about $1\frac{1}{2}$ or 2 miles, which is also agreeable to observation.

Lastly, as the density and rarity of the vapour is chiefly owing to its degree of heat, and in a small measure to the encreased or diminished pressure of the circumambient air, and the density and rarity of the air is chiefly owing to the encreased or diminished pressure, by the accumulation or exhaustion of superior air, whilst heat and cold alter its density in a much less proportion ; the vapours instead of conforming themselves to the altered density of the ambient air, will rise when it is condensed, and sink when it is rarefied ; and also rise or sink (when the pressure of the air is not altered, and its density very little changed) by their different dilatation, owing to heat or cold ; and so will often change their height considerably, whilst the barometer continues exactly at the same degree, and the thermometer rises or falls very little, or not at all.

As for the manner how clouds are changed into rain, I have hinted it in the beginning of this paper ; but for farther satisfaction I refer the reader to Dr. Halley's account of it in the Phil. Trans. n. 181 *.

XII. The account we have of the universal deluge is no where so express as in the holy scriptures ; and the exact circumstances as to point of time shew that some records had been kept thereof more particularly than is wont in those things derived from remote tradition, wherein the historical minutiae are lost by length of time. But it seems much too imperfect to be the result of a full revelation from the author of this dreadful execution upon mankind, who would have spoke more amply as to the manner thereof, had he thought fit to lay open the secrets of nature to the succeeding race of men ; and I doubt not but to all that consider the 7th chap. of Genesis impartially, it will pass for the remains of a much fuller account of the flood left by the patriarchs to their posterity, and derived from the relation of Noah and his sons. It must be granted, that there are some difficulties as to the construction of the ark, the reception and agreement of the animals among themselves, and the preservation of it in so immense and boundless an ocean, during that wind which God sent to dry the waters away, especially when it first came on ground : but it must also be allowed that length of time may have added as well as taken away many notable circumstances, as in most other cases of the story of remote times and actions.

* Vol. II.
C 1. §. ix, x.
*Of the cause
of the univer-
sal deluge.*
Written in
1699 by
Dr. E. Hal-
ley. n. 383.
p. 118. May,
&c. 1724.

This we may however be fully assured of, that such a deluge has been; and by the many signs of marine bodies found far from and above the sea, 'tis evident that those parts have been once under water: or either that the sea has risen to them, or they have been raised from the sea; to explicate either of which is a matter of no small difficulty, nor does the sacred scripture afford any light thereto. All that it says to help us is, that all the fountains of the great deep, *תְּהוֹם וְכָבֵד*, were burst or broken up; that the windows or cataracts of heaven were opened, and that it rained incessantly forty days and nights. Now the rain of forty days and nights will be found to be a very small part of the cause of such a deluge; for supposing it to rain all over the globe as much in each day as it is now found to do in one of the rainyest counties of England in the whole year, viz. about forty inches of water per diem, forty such days could cover the whole earth with but about twenty two fathom water, which would only drown the low lands next the sea, but the much greater part would escape. What is meant by the fountains of the abyſſe being broken up, and the opening of the windows of heaven, seems not ſo easy to be understood, but is intended to indicate the modus of the deluge, which was according to the Mosaic philosophy, from the letting in of the waters above the firmament, mentioned Gen. i. 7. by the windows of heaven; and the rising up out of the ground of the waters under the earth, spoken of in the second commandment: Or, (if you will understand that by the *תְּהוֹם וְכָבֵד* is meant the great ocean) by the overflowing of the sea rising upon the land, which is expressed by the breaking up of the fountains of the great deep. So that we may reasonably conclude that by the one of those expressions is meant an extraordinary fall of waters from the heavens, not as rain, but in one great body; as if the firmament, supposed by Moses to sustain a supra-aerial sea, had been broken in, and at the same time the ocean flowed in upon the land so as to cover all with water.

By an extraordinary encrease of the waters this could not be effected, for that at this time there is not water sufficient of itself to cover any more of the earth than now it doth; and to suppose a creation and annihilation of water on purpose to destroy the earth, is by much the most difficult hypothesis that can be thought of to effect it. A change of the center of gravity about which the sea is formed seemed no improbable conjecture, till it appeared that this center of gravity was the necessary result of the materials of which our globe consists, and not alterable whilst the parts thereof remained in the same position. Besides, this supposition could not drown the whole globe, but only that part thereof towards which the center of gravity was translated, leaving the other hemisphere all dry.

I shall say nothing of Dr. Burnet's hypothesis, nor of the many insufficiencies thereof, as jarring equally with the physical principles of nature.

Of the cause of the universal deluge.

nature and with the holy scriptures, which he has undertaken to reconcile. Dr. Hook's solution of this problem, as he has not fully discovered himself, I cannot undertake to judge of: his compression of a shell of earth into a prolate spheroid, thereby pressing out the waters of an abyss under the earth, may very well account for drowning two extremest opposite zones of the globe; but the middle zone, being by much the greater part of the earth's surface, must by this means be raised higher from the center, and consequently arise more out of the water than before; and besides, such a supposition cannot well be accounted for from physical causes, but require a preternatural digitus Dei, both to compress and afterwards restore the figure of the globe.

But the Almighty generally making use of natural means to bring about his will, I thought it not amiss to give the Society some thoughts that occur'd to me on this subject; wherein if I err, I shall find myself in very good company.

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§. xvii.

In the Transactions, n. 190. † I propos'd the casual choc of a comet, or other transient body, as an expedient to change instantly the poles and diurnal rotation of the globe; at that time only aiming to shew how the axis of the earth being changed would occasion the sea to recede from those parts towards which the poles approached, and to encrease upon and overflow those parts from which the poles departed; but I did not then consider the great agitation such a choc must necessarily occasion in the sea, sufficient to answer for all those strange appearances of heaping vast quantities of earth and high cliffs upon beds of shells which once were the bottom of the sea, and raising up mountains where none were before, mixing the elements into such a heap as the poets describe the old chaos to have been. For such a choc impelling the solid parts would occasion the waters, and all fluid substances that were unconfined, with one impetus to run violently towards that part of the globe where the blow was received, and that with force sufficient to rake with it the whole bottom of the ocean, and to carry it upon the land, heaping up into mountains those earthy parts it had born away with it, in those places where the opposite waves ballance each other; which may account for those long continued ridges of mountains. Again, the recoil of this heap of waters would return towards the opposite parts of the earth with a lesser impetus than the first, and so reciprocating many times would at last come to settle in such a manner as we now observe in the structure of the superficial parts of the globe.

In this case it will be much more difficult to shew how Noah and the animals should be preserved, than that all things in which was the breath of life should be destroyed. Such a choc would also occasion a differing length of the day and year, and change the axis of the globe according to the obliquity of the incidence of the stroke, and the direction

rection thereof in relation to the former axis. That some such thing has happened may be guessed, for that the earth seems as if it were new made out of the ruins of an old world, wherein appear such animal bodies as were before the deluge, but by their own nature and defences from the weather have endured ever since, either petrified, or else entire, in statu naturali. Such a choc may have occasioned that vast depression of the Caspian sea, and other great lakes in the world; and 'tis not unlikely but that extreme cold felt in the north-west of America, about Hudson's-bay, may be occasioned by those parts of the world having once been much more northerly, or nearer the pole than now they are; whereby there are immense quantities of ice yet unthaw'd in those parts, which chill the air to that degree that the sun's warmth seems hardly to be felt there.

2. I have been advised by a person whose judgment I have great reason to respect, that what I have advanced above ought rather to be understood of those changes which might have happened to the earth in times before the creation, and which might possibly have reduced a former world to a chaos, out of whose ruins the present might be formed, than of the deluge whereby mankind was in a manner extinguished about 4000 years since; that being much more gradually brought to pass, and with some circumstances that this hypothesis cannot admit of, which abler pens may perhaps account for. What I have advanced I desire may be taken for no more than the contemplation of the effects of such a choc as might possibly, and not improbably, have befallen this lump of earth and water in times whereof we have no manner of tradition, as being before the first production of man, and therefore not knowable but by revelation, or else a posteriori, by induction from a convenient number of experiments or observations, arguing such an agitation once or oftner to have befallen the materials of this globe. And perhaps in due periods of time such a catastrophe may not be unnecessary for the well-being of the future world; to bury deep from the surface those parts which by length of time are indurated into stony substances, and become unapt for vegetable production by which all animals are either immediately or mediately sustained: the ponderous matter in such a mixture subsiding first, and the lighter and finer mould remaining for the latter settling, to invest the exterior surface of the new world. This may perhaps be thought hard, to destroy the whole race for the benefit of those that are to succeed. But if we consider death simply, and how that the life of each individual is but of a very small duration, it will be found that as to those that die it is indifferent whether they die in a pestilence out of 100,000 per ann. or ordinarily out of 25,000 in this great city, the pestilence appearing terrible to those only who survive to contemplate the danger they have escaped.

N.B. Mr. Whiston's new theory of the earth was not published 'till about a year and a half after the date of this paper.

*Farther
thoughts on
the same sub-
ject. By the
same. ibid. p.
123.*

XIII. The weather observed in a voyage to Hudson's Bay, in 1730, by Mr. Chr. Middleton. n. 418. p. 76.

D. M.	Barom. altitud.	Therm. altitud.	Latit. N.	Longit. W.	Variat. W.	Obf.	Wind.	Weather.
June 4	27	25	59° 12'	4° 44'	17° 00'	Obf.	S W.	Clofe.
5	22	25	59 38	5 11	16 00	Obf.	S W to N W.	Rain, and stormy winds.
6	21	24	59 58	5 57	17 00		W S W.	Rain, and fresh gales.
7	22	23	59 22	7 06	17 20		N W to SSW.	Rain and squally with fogs.
8	22	22	59 38	8 39	18 00	Obf.	S W to S E.	Much rain all night, fair at
9	23	22	59 54	8 47	18 00		N E.	Very cloudy. (noon.
10	20	22	59 14	10 14	18 00		North.	First part squally, lat. fair.
11	22	22	58 35	11 23	18 00		N W.	Squally with rain.
12	22	25	57 21	12 20	18 00		N W.	Cloudy, with small rain.
13	22	24	56 31	13 13	18 00		N W.	Squally.
14	25	25	56 00	14 22	18 00		N W to S.	First part squally, lat. hazy
15	24	25	55 53	17 02	18 00	Obf.	E to N.	Squally, and fresh gales.
16	20	23	55 42	18 16	18 00		N E to S W.	Cloudy.
17	19	23	56 21	18 47	18 00		S W to N W.	Rain and stormy.
18	18	22	55 22	19 34	18 30		N W.	Squally with rain.
19	20	23	55 42	21 14	19 00		NNE to WbS.	Cloudy with rain, uncertain.
20	21	24	56 51	21 31	19 30		N W.	Fresh gales and foggy.
21	21	24	57 23	21 54	20 00		WNW to WbS.	An hard rain, and stormy.
22	21	24	57 00	22 01	20 00		N E to W.	Hard gales for the most part.
23	21	24	57 56	23 52	21 00		W S W.	Fresh gales, but cloudy.
24	23	24	58 16	24 09	22 00		W to WNW.	Hard gales, cloudy.
25	24	23	57 40	24 38	22 00	Obf.	WNW to SW.	Cloudy, little wind.
26	23	23	57 57	25 33	22 00		S W.	Little wind, and foggy.
27	22	22	58 47	28 25	23 00		S W to W.	Foggy, and squally.
28	23	22	58 39	29 31	23 00		W to N N W.	Fresh gales, rain.
29	24	21	58 28	29 45	23 20		N W to W.	Moderate and calm.
30	25	22	58 00	30 38	24 00		W to S W.	Moderate, cloudy.
July 1	22	22	58 25	29 34	24 00	Obf.	W S W.	Moderate and clear.
2	20	22	59 13	32 54	25 00		S W to W.	Frequent squalls, some rain
3	24	21	59 03	33 14	25 00	Obf.	W N W.	Moderate and cloudy.
4	25	22	58 54	33 30	25 00		W N W.	Fair, sometimes calm.
5	20	22	58 43	35 44	26 00	Obf.	S S E.	Sometimes calm. Fair.
6	20	22	58 26	37 25	26 30		S S E to W.	Stormy, and rain.
7	21	20	58 06	39 30	27 30	Obf.	WNW to SE.	Moderate. Little wind.
8	22	20	58 03	42 38	27 00		S to S W.	Foggy.
9	24	22	57 34	43 23	27 00		N N W.	Foggy. Little wind.
10	24	24	57 43	45 25	27 00	Obf.	N N W.	Fresh gales and clear.
11	28	28	58 11	46 47	27 00		WbS to N N W.	Cloudy, with small rain.
12	29	26	57 34	48 17	28 00	Obf.	NNW to SSW.	Fair.
13	29	26	58 00	50 48	29 00		S W.	Hazy.

The weather in a voyage to Hudson's bay.

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D. M.	Barom. altitud.	Therm. altitud.	Latit. N.	Longit. W	Variat. W.	Obf.	Wind.	Weather.
July 14	28	26	58° 53'	53° 20'	31° 00'		S W to W b S.	A thick fog.
15	33	35	58	56	55 18		WNW to NW.	Small rain, and squally.
16	38	37	59	06	55 33		NbW to NW.	Several isles of ice.
17	40	38	58	50	56 04		N N W.	Fair and clear. Very cold.
18	41	39	58	53	56 43	Obf.	NW to WSW.	Very cold. Much ice.
19	40	38	59	45	58 03	Obf.	NW to WSW.	Fair and clear.
20	40	38	60	01	58 27		N N W.	Fair and moderate.
21	42	38	59	51	59 37		NNW to SE b S	Fair.
22	43	38	61	16	62 09		S S E.	Hazy.
23	43	39	61	50	63 34		S E.	In Hudson's streights.
24	42	38	62	11	72 32	Obf.	S E.	Foggy.
25	40	35	63	11	76 22		S E.	Rainy and cold.
26	41	37	63	12	78 04	Obf.	S E.	Little wind, and clear.
27	39	39	63	09	78 43		East.	Little winds, sometim. calm.
28	37	38	62	10	81 12		S E to W b N.	Squally, with much rain.
29	35	37	60	49	82 21		W b N to N E.	Gentle rain. A fresh gale.
30	38	36	58	24	84 09		N to N N W.	Much ice all round.
31	40	38	56	51	84 27		N W.	Fair and clear. Ice still.
Aug. 1	43	39	56	15	83 46	Obf.	NW to WSW.	Fair. Ice as before.
2	42	38	56	20	84 16	Obf.	S b W.	Mercury inclosed in ice. Fair.
3	40	38	56	27	83 44		South	Still in ice. Fresh gales.
4	38	36	56	20	83 01		S W.	Foggy, and much ice.
5	38	35	56	15	83 24		E S E.	Much rain, and foggy.
6	40	37	56	00	82 46		W S W.	Fair and moderate.
7	40	39	55	08	82 43		E N E.	Lightning, with some rain.
8	38	36	55	11	82 43		N to N N W.	Fog. fr. gales. Jambed in ice.
9	38	36	55	16	82 43		N N W.	Frost and calm.
10	34	31	55	22	82 40		South.	Fair and pleasant.
11	34	32	55	11	84 20		S W to N W.	Moderate.
12	31	30	55	06	84 36		NNW to S b E.	Moderate and fair.
13	27	30	55	15	84 52		S to S S W.	A fresh gale. Much ice.
14	26	30	55	20	84 34		S b W.	Hard gale. Thunder & rain.
15	26	27	54	44	84 34		WNW to NW	Fresh gales. In ice.
16	29	27	54	28	84 34		NW to N.	Moderate and fair.
17	26	27	53	54	84 56		N E to S b E.	Clear of ice. Fair.
18	25	25	53	56	84 58		W b N to WSW.	A fresh gale. Clear of ice.
19	25	24	53	44	84 57		WSW to W b N.	Moderate and fair.
20	28	26	53	09	85 00		W b S to S E b S.	Moderate and fair.
21	28	25	52	31	85 30	Obf.	E to N E.	Moderate.

In ALBANY road.

22	27	25	50° 29'	85° 20'	23° 00'	N W to S E.	Moderate and fair.
23	26	22				S W.	Dry. Somewhat cloudy.
24	26	21				W N W.	Mercury at a stand.

The time I was on shore not observed. From ALBANY.

Sept. 2 | 25 | 20 | 53° 56' | 0° 30' E | 24° 00' | S S W. | Hazy, but small gales. From

The weather in a voyage to Hudson's bay.

From the B E A R Islands.

D. M.	Barom. altitud.	Therm. altitud.	Latit. N.	Longit. W.	Variat. W.	Obf.	Wind.	Weather.
Sept. 3	35	32	54° 22'	0° 7' W	24° 00'		SW to NE b N.	Merc'. suddenly falls to free-
4	40	37	55 45	0 49 W	25 00		NNE to WSW	Hard frost. Fair. (zing.
5	37	36	56 35	2 26 W	26 00		E b N to NE.	Cold air. Squally & foggy.
6	37	35	56 57	3 04 W	26 00		N E.	A wet fog.
7	37	34	56 45	1 22 W	26 00		N E.	Moderate gales.
8	38	36	57 06	3 26 W	26 00		N E b N.	Fresh gales.
9	36	36	58 08	3 02 W	28 00		N b E to W.	Foggy.
10	36	38	60 25	2 02 W	33 00		WSW to NW b N	Fresh gales. Wet fog.
11	35	38	61 49	0 42 E	38 00		NbW to NbE.	Moderate, but cold air.
12	34	37	62 33	0 51 E	42 00	Obf.	NbE to NNW.	Fresh gales, squally with rain.

From D I G G S.

13	33	34	63° 20'	1° 20' E	43° 00'	Obf.	All round.	Sometimes calm.
14	32	35	63 03	2 34 E	40 00		SbE to NNW.	Squalls, show. of snow & hail.
15	32	36	62 09	19 19 E	42 00		NW to NNW.	Stormy, freq. show. of snow.

From B U T T O N ' S Islands.

16	31	35	61° 10'	0° 29' E	39° 00'		NbW to NNW	Many isles of ice and snow
17	30	34	60 35	6 09	34 00		NW to N.	Fresh gales & freq. squalls
18	30	34	58 52	10 39	34 00		NNW to NNE	Squally, with show. of snow
19	30	35	57 54	14 06	32 00		N W.	Squally, with hail.
20	30	34	57 28	16 15	30 00		NW to SbW.	Squally, with hail & rain.
21	31	33	57 38	18 24	28 00		SbW to WSW.	Hard squalls, some rain.
22	30	35	56 19	22 27	25 00		WSW to NW	Stormy, with some hail.
23	30	36	54 40	27 43	22 00		N W.	An hard storm, with hail.
24	29	36	53 28	32 28	21 00		WNW to SSW	High winds, with hail.
25	31	35	53 34	35 16	19 00		S to W S W.	A storm. Wind and rain.
26	33	34	52 46	36 27	18 00		W to S W.	More moderat. Fresh gales,
27	33	34	52 21	39 11	17 00		SSW to NW.	Squalls of rain. (rain.
28	32	34	50 35	42 10	16 00		N. to W b S.	Frequent showers of rain.
29	30	33	50 41	46 23	15 00		SWbW to SSW	Very squally, with lightn.
30	32	32	50 07	49 09	14 00		S W.	An hard gale, with rain.
Oct. 1	35	31	49 26	51 57	14 00		SW to NNW.	More moderate and fair.
2	30	33	49 30	53 45	14 00		N E.	Moder. & fair. Little wind.
3	25	30	49 56	54 34	13 00		S E.	Fresh gales, with rain.
4	25	30	49 19	54 10	13 00		S to E.	A storm. Wind and rain.
5	25	29	49 47	53 50	13 00		E b S.	An hard storm, with rain.
6	29	28	50 10	53 26	13 00		E S E.	Stormy, with thunder.
7	31	27	49 58	53 48	13 00		East.	More moder. cloudy, some
8	32	29	49 21	55 19	13 00		E to S S W.	Foggy with some rain. (rain
9	32	30	49 45	58 49	13 00		WSW to SbW.	Fresh gales, with rain.
10	33	28	49 56	61 37	13 00	Obf.	S to S S W.	Fair & mod. for the most part

Off Plymouth.

These Observations were made by Mr. John Patrick's new quicksilver marine barometer.

Note, The altitude of the barometer and thermometer were taken at noon.

The account of wind and weather at sea is from noon to noon.

The effects of a violent rain in Yorksbire.

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XIV. Besides a funnel and proper receptacle for the rain, I use a cylindrical measure and gage. The funnel is 30 inches diameter, and the cylindrical measure exactly 3; the depth of the measure is 10 inches, and the gage of the same length, with each inch divided into 10 equal parts; or, instead of a gage, the inches and divisions may be marked on the side of the cylindrical measure. The apparatus is simple and plain, and it is easy to apprehend the design and reason of the contrivance; for the diameter of the cylindrical measure being just $\frac{1}{3}$ of that of the funnel, and the measure exactly 10 inches deep, 'tis plain that 10 measures of rain make an inch in depth; one measure, $\frac{1}{10}$; one inch on the gage, $\frac{1}{100}$; and $\frac{1}{10}$ of an inch on the gage, $\frac{1}{1000}$, &c. By this means the depth of any particular quantity which falls may be set down with ease and exactness, and the whole at the end of each month or year summed up without any trouble.

The depth of rain fallen from Apr. 1. 1722, to Apr. 1. 1723, at Widdrington in Northumberland. By Mr. Horsley, n. 377. p. 328 May, &c. 1723.

Some of the summer months, particularly May and July, were very wet, and some of the winter ones very dry; so that, one with another, this year's rain, as far as can well be conjectured, may be looked upon as a medium. And if so, it differs not above two or three inches from the mean quantity of rain which falls at Upminster, Paris and Lisle, being less than at Lisle, and more than at the two other places.

Inch.	Inch.	Inch.	Inch.
In April - 1,015	In July - - 4,350	In Oct. ,600	In Jan. 1,225
In May - 3,532	In August 2,132	In Nov. 2,205	In Feb. ,485
In June - 2,570	In Sept. - 1,155	In Dec. 1,780	In March ,195
In the whole year - - - 21,244			

XV. The effects of a violent shower of rain at Ripponden near Halifax were so surprizing, that I wrote to a Gentleman in those parts for an account that might be depended upon; and particularly desired to know whether there was not an eruption of waters out of the hills, as the late ingenious Mr. Townley wrote me there was out of Pendle-Hill, in that at Star-bottom mentioned in the Philos. Transf. n. 245. ‡ but all the account I can learn of this is, that what they call the dashing of two great watry clouds upon the hills occasioned the inundation. Whatever was the more immediate cause, the effects were dismal, and so sudden that though it was in the day-time the poor creatures could not save their lives. This calamity happened the 18th of May, 1722. betwixt the hours of 3 and 5, when by the modestest account the beck was raised two yards at least in perpendicular height above what was ever known before; which may be easily conceived from the situation of the place implied in the Saxon termination *den*, signifying a deep valley between pretty steep hills on each side. Several houses, four mills, (some say six) nine stone-bridges, and

The effects of a violent shower of rain in Yorksbire. By Mr. R. Thoresby, n. 372. p. 101. Jun. &c. 1722. † Vol. II. C. II. § xxxiv.

Effects of lightning in Northamptonshire.

and ten or eleven of wood were carried away, and the wheels, dams, and sluices, (called in Yorkshire goits, from the saxon *geotan*, *fundere*) of most of the mills that are left standing, broken and damaged; and a great deal of cloth gone. Fifteen persons were drowned, two of whom are not yet found. Seven out of eight in one house were either slain by the fall of it, or drowned. A young man who escaped by help of a piece of timber, was turned over and over again in passing two or three dams, but at last taken out alive though distracted for the present.

The rapidness of the torrent was so violent that it took down the north-side of Ripponden chapel, and carried off most of the seats. A man of Deusbury told me that four of them were driven to that town; and the Rector of Castleford informed me that many goods were carried down so far, though above 20 miles off. It tore up the dead out of their graves; at first I believed it only of one who had been buried that afternoon, and so the earth not fully settled again; but am since informed by a sure hand that two corrupted corpses were driven upon one gentleman's land, and two upon another's. It swept away all the corn-land as deep as the plow had gone. Some saved themselves by forcing a way out of the roofs of their houses, and sitting upon the ridges 'till the floods abated.

Effects of lightning in Northamptonshire. By Mr. J. Wasse. n. 390. p. 366.

XVI. July 3. 1725. at Mixbury, a storm of thunder and lightning began about half an hour past 1 in the afternoon, and lasted with intermissions for an hour. About 2. W. Hall, aged above 60, was found dead in a hard gravelly field, together with 5 sheep which lay round him at about 30 yards distance; but that only which lay nearest him had a visible wound, which was through the head, the ground being torn up near two yards round about it. The shepherd lay partly upon his side; the upper part of his head was terribly fractured, and his right knee was out of joint; he had a wound in the sole of his foot towards the heel; his right ear was cut off and beaten into his skull, and blood flowed out of that part upon the ground. All his cloaths and shirt were torn into small pieces and hung about him; but from the girdle downwards were carried away entirely, and scattered up and down the field. Particularly, the soles of a strong pair of new shoes were rent off. His hat was driven to pieces: I have a hand-breadth of it full of irregular slits, and in some few places cut as with a very sharp penknife, and a little singed in the upper part. His beard and the hair of his head were for the most part close burnt off. The iron buckle of his belt was thrown 40 yards off, and a knife in the right side pocket of his breeches had the haft and the hinge that goes into it shivered to pieces, but was not melted. Near each foot appeared two round holes which I ordered my nephew to search; they were about five inches in diameter, and almost perpendicular for half a yard, but after that grew narrower; in both of them the matter divided into two parts, and

Effects of lightning at Worcester.

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and formed horizontal cavities about three inches diameter. In one he found a very hard glazed stone, about ten inches long, six wide, and four thick, cracked in two : others it could not pierce, but was turned here and there out of its course, yet left not the least blackness or other discolouring any where. I have seen an iron ball shot out of a mortar almost perpendicular, which upon a like gravelly soil made not a greater impression. To make a gross estimate of the force, I took a cohorn charged with three quarters of a pound of very good powder wadded with thick paper, and fired it against a stone of the same dimensions, but not so hard, which it shattered to pieces at half an inch distance. But in the other blow we have above treble the effect, without any discoverable particles at all ; and yet it seems to fly like small shot ; pierces only here and there, and leaves a good many places quite untouch'd, as is evident from the hat which I have by me. To confirm this, J. Marshal of this town assures me that in the middle of the same storm he received a blow upon his hat, which rattled like shot through the branches of a tree: It beat in the crown a little without penetrating it; yet he staggered and was giddy for two days afterward. Two of his sons were at the same instant both knocked down to the ground, one of whom says he thought he had been felled with a beetle; they were stunn'd a little, but presently came to themselves and have no wound. May not this be accounted for by supposing the flame to rarefy the air and make a sort of vacuum about one; into which when it returns again, it gives a stroke as with a beetle? I fancy a wind-gun would have the same effect. About the time this accident happened, one in the same town observed a fire-ball as large as a man's head to burst in four pieces near the church. I myself heard the hiss of one which flew over my garden, from S. E. to N. W.

2. June 10. 1724. we had continued lightning in the east from eight o'clock at night to twelve; the weather for some time before having been very sultry, the wind at N. E. and the barometer at settled fair. Next morning the mercury sunk, and the sky became more cloudy and temperate, except a few hot gleams; at two in the afternoon several fierce showers fell, attended with flashes of lightning and claps of thunder that still approached nearer us. Between two and three a flash came so violently upon me, succeeded so very quick by a low, unusual, dreadful sound, that I immediately went to the door fearing some mischief near. I was soon called to an officer's lady (aged about 18, and breeding) killed by it in the adjoining street. I found her yet warm, and that she had survived the stroke for six or seven minutes. The fire-marks they shewed me were streaks of a copper-colour, branched from the left shoulder all over the thorax, and interspersed here and there with irregular spots, which gave occasion for that conceit published in our news; that curious plants were drawn on her bosom as with the finest pencil. This sad accident happened in a parlour-window next the street, that could contain about

..... at Wor:
cester. By
Dr. R. Beard.
p. 394. p.
118.

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two persons. The lady, it seems, terrified with the repeated lightning and thunder, it having formerly been fatal to her brother, desired an officer to change places with her that she might be near her husband; but she was no sooner seated by him, than she inclined sideways and spoke some words; after she was carried to another room she said she was gone, and then that she was blind, and asked for water. The husband was thrown along, together with the fortunate gentleman that had just resigned his seat; and a large looking-glass was lifted off the hooks. The landlord's daughter being at work near the lady perceived such an impulse on the side of her head that her hearing was much impair'd, and upon every peal of thunder since she is affected in like manner, though not so strongly. The gentlemen complained that they were stupified, forced down they did not know why, unless it were for want of breath; and of pains and numbness in their limbs. They had likewise on different parts of their bodies such reddish wheals as were seen on the fair lady's breast: but these symptoms vanished the next day. The other two persons at the further end of the room were untouched; they were all sensible of a sulphurous smell. The pane of glass exactly behind the lady's waist was perforated by a round hole of an inch and half diameter, as if done with a diamond, or rather a wind-gun; but nowhere thereabouts could I discern the least traces of fire or heat, nor on the lady's cloaths (having no stays on) the signs of any violence. On a more nice examination of the body that evening in the presence of the friends I discovered on the left loin, taking in part of the spine of the os ilium which was somewhat swollen, a deep contusion of the same dimension with the breach in the glass: the skin was neither indurated nor pierced: the blood in the capillaries all round, but chiefly up the back, settled, the colour of which was easily distinguished from that of the streaks, and the circular impression.

The phenomenon that caused this misfortune rose from the N. E. first slid off the gabel-beam and the bricks on the back part of the next house, filled a little court with flame and smoke, then turned a leaden spout contrary to its former direction, mounted over the roof, and cracking a stack of chimneys darted down at the window where the husband and wife sat. Some credible people that saw it, to their great terror, assure me that it was a ball of fire, and that it burst with the loudest report they ever heard, and then with a hissing noise passed about a yard from the ground through an adjacent street and rolled off to the S. W. Some workmen there and on a neighbouring hill observed the same.

In my opinion the mortality of this blow may be accounted for from the known effects of imprisoned air only when set at liberty, as the appearances on the skin may from other active particles hurried along with it at the time of the explosion. The impetus being first received

received on the parts described, occasioned her death to be less sudden than usual in such cases.

3. Dec. 6. 1729. In the afternoon there happened at Pencarreg a terrible storm of thunder and lightning, and about four, as the wife of one Morgan was carrying a pail of water into the house, she was no sooner got over the threshold into a small entry that leads towards the fire, than there broke such a violent clap of thunder that she and three of her children were thereby struck down and bereaved of their senses, and in this condition they lay they know not how long, weltring in their blood, without being able to creep to bed, 'till the next neighbour happened to come in to assist them, the husband being then abroad at his day-labour. The lightning entered at the east end, near the foundation, into the hearth, and cleft in two a thick stone of about half a yard in breadth beyond the fire; one part whereof still remains, and that split, but the other was shattered into small particles and splinters which did the most hurt; about twenty-four or more of them being taken out of their wounds. Afterwards it forced its way out through the wall on the south-side within the compass of the hearth, where it made a terrible breach from top to bottom, removed the stones from the foundation, and made a deep hole perpendicular in the earth, that one might thrust in a staff to the wrist, as the woman herself informed me. By the violence of it the brand-irons and legs thereof were strained, and so burnt, that upon endeavouring to streighten them they fell a-sunder like rusty iron, or timber worm-eaten. The partitions in the house, which were of no strong substance (being walled, such as they have in the country) were moved out of their place, and a chest full of corn forced down towards the door some yards from where it stood. The bucket which the woman had in her hand, and the other wooden vessels in the house, were all or most of them shattered, dishes and spoons, &c. blown away, and after some days found in the garden, on the north-side of the house, split and broken, and some yarn that was hanging in the top of the house was found out of doors a while after; and many more disorders than I am able to recount at present.

The woman has quite lost her left eye; the poor creature was speechless for a week or nine days, and could not swallow. She has lately had a few stones come out from the roof of her mouth, from under her tongue, and other parts inwardly: the tip of her tongue taken off, as far as I can guess, for she is still lisping; three of the fore teeth of the under jaw broken, with the lower lip slit, but now pretty well healed; two of the right-hand fingers, the second and third quite taken off, and the colour of that hand still like a flame of fire. She has a terrible gash upon that shoulder between the joints, that once one might hide an egg in it, and very painful, besides 3 or more bruises

..... in Caermarthenshire.
By Mr. E. Davies. n.
416. p. 444.
Nov. &c.
1730.

Effects of lightning in Worcestershire.

upon the arm down to the wrist, that she is not able to lift it up without the help of the other hand, besides several other wounds and bruises over great part of her body. A boy (an idiot) had his hair all singed, his face and breast all scorched with blisters like bladders running from the raw flesh, and several stones were taken out of his body and legs: two other small children suffered greatly; only one girl about ten years old that stood at a distance next the door escaped, having her cloaths singed, but no other hurt done her. I had almost forgot to mention that several splinters of bones were taken out in dressing their wounds. It is worth observing also, that they smelt so strong of sulphur for some days that one could hardly go near them. They are now free from any grievous pain, so that they go about.

This account was sent me by Mr. Jenkin Jenkins a clergyman who lives in that neighbourhood: about half a year after I went that way, and viewed the breach made in the house and the wounds which the woman and her children had received by the stones lodged in their bodies, some of which were not then healed. The woman then gave me a little piece of stone, which she said she had taken out of her tongue about five months after this disaster.

*... in Wor-
cestershire.
By Dr. R.
Beard. n. 394.
p. 120.
May, &c.
1726.*

4. June 4. 1726. We had more lightning and thunder the week past, than ever has been known in that space of time: and what was more extraordinary, it continued for nine or ten hours together with little or no intermission, and at a great height above us. So far has this been from doing any considerable damage near us, that in the opinion of the country-farmers it had very good effects, especially at the beginning during the heat: for the little insects, that in some places threatened the destruction of the hops and some other plants, fell off like bees by the steam of a lighted match. I know not whether this has been observed before; but I saw such remarkable instances of it in certain situations, that I could not help giving this short account of it.

** Vol. IV.
P. 11. p. 113.
Concerning
the frost in
Jan. 1731.
By Mr. W.
Derham.
n. 417. p. 16.
Jan. &c.
1731.*

XVII. In the phil. trans. n. 324. * I have given an account of some of the most remarkable frosts, particularly of that great and, I had almost said, universal one, in 1708.

There I have made it very probable that the greatest descent of the spirits in the thermometer was on Dec. 30, 1708, when my glass was within $\frac{1}{8}$ inch as low as it can be reduced by artificial freezing with snow, or ice and salt: and in the late frost it was almost, if not altogether, as low.

The freezing-point of my thermometer is ten inches (which I call 100 degrees) above the globe of spirits; and the most intense freezing is just at, or very little within the ball. And on Jan. 30, about sun-rising, the thermometer was but an inch or ten degrees above the point
of

Water frozen almost instantly.

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of extreme freezing; and on Feb. 3. at only half an inch or five degrees. And considering that the thermometer I observed with in 1708 was less accurate and differently graduated from that which I now have, I am apt to think that the frost in Feb. 3. last, was altogether as intense as that on Dec. 30. 1708. For although a frigorific mixture sunk the spirits but one tenth lower in the old thermometer, and about five or six tenths in that I now observe with, yet I take the difference to be little, or none at all, by reason of the tendernefs of the new above the old glass.

And this degree of cold I take to be as excessive as in any of the years mentioned in the said transaction; yea, any of the years when the Thames at London was frozen over: I am sure greater than in 1716, when that river was frozen over for several miles, and booths and streets were made on the ice, and an ox roasted whole thereon, &c. For the lowest point of freezing in 1716. was on Jan. 7. when the spirits fell to 35 degrees only of the glass I now use: but the true cause of the freezing of the Thames that year was not barely the excess of the cold, but the long continuance of it: which was also the principal cause of those remarkable congelations of that river in 1683 and 1708, when I saw coaches driven over the ice, and large fires made on it, &c.

XVIII. Dec. 15. 1729. Coming into the hall where my apparatus is placed in the palace of the nobility at Stockholm, the weather being very cold I feared that the glass for shewing the experiment with the Cartesian devils (or those glass figures in water, which by the pressure of the air on the surface of the water, are made to change their places and sink to the bottom of the glass) would be in danger, if the water should freeze in it. I took it down from the shelf, and was well pleased to see the water in a fluid state; but before I would empty the glass, as some friends that were present had not seen that experiment, I placed my hand on the bladder tied on the top of this cylindrical glass, which was of a pretty large size, being sixteen inches high and three inches and a half diameter, containing three glass figures. In that very instant, and in the space of a second of time, I found all the water changed into ice; when in the mean while two of the figures had reached very near the bottom, but the third, as well as they, fixed in the middle of the glass, surrounded with ice as transparent as the water it self before it congealed. This is, in a few words, the matter of fact; but why the whole body of water should in such a short space of time turn into ice, is, in my humble opinion, not easily to be accounted for.

XIX. Antequam experimentorum recensioem aggrediar, necesse erit ut pauca de thermometris quæ a me construuntur, eorumque scalæ divi-

in vacuo. By D. G. Fahrenheit. n. 382. p. 78. March, &c. 1714.

Water frozen almost instantly. By Mr. Martin Triewald. n. 418. p. 79. March, &c. 1731.

Experiments on the freezing of water &c. 1714.

Experiments on the freezing

sione, ut & de methodo evacuandi qua usus sum præmittam. Duo potissimum genera thermometrorum a me conficiuntur, quorum unum spiritu vini, alterum argento vivo repletur: longitudo varia est, pro usu cui inservire debent: omnia autem in eo conveniunt, quod in omnibus scalæ gradibus concordent interque limites fixos variationes suas absolvant. Thermometrorum scala quæ meteorologicis observationibus solummodo inserviunt infra a zero incipit & 96^{to} gradu finitur. Hujus scalæ divisio tribus nititur terminis fixis, quorum primus in infima scalæ parte reperitur, & commixtione glaciei, aquæ & salis armoniaci vel etiam maritimi acquiritur; huic mixturæ si thermometron immergatur, fluidum ejus usque ad zero descendit. Melius autem hyeme quam æstate hoc succedit. Secundus terminus obtinetur, si aqua & glacies absque memoratis salibus commisceantur; immerso thermometro huic mixturæ, fluidum ejus 32^{um} occupat gradum, qui terminus initij congelationis a me vocatur; aquæ enim stagnantes tenuissima jam glacie obducuntur, quando hyeme liquor thermometri hunc gradum attingit. Terminus tertius in 96^{to} gradu reperitur; & spiritus usque ad hunc gradum dilatatur si thermometrum in ore vel sub axillis sani hominis teneatur donec perfectissime calorem corporis acquisiverit. Si vero calor hominis febris vel alio morbo fervente laborantis investigandus est, alio thermometro utendum cujus scala usque ad 128 vel 132 gradus prolongata est: vix enim credendum ullius febris fervorem gradus memoratos excedere. Thermometrorum scala, quorum opere ebullientium liquorum gradus caloris investigatur, etiam a zero incipit & 600 continet gradus; hoc enim circiter gradu mercurius ipse (quo thermometron repletum est) incipit ebullire.

Ut autem thermometra ab omnibus caloris mutationibus afficiantur, loco globulorum cylindris vitreis sunt prædita, eo enim modo ob majoris superficiei quantitatem citius a variatione caloris penetrantur.

Fig. 6.

Nunc describendus est modus evacuandi quo in experimentis sequentibus usus sum. Globulus vitreus A, tubulo BC duorum vel trium pollicum longo in extremitate C attenuato præditus, supra ignem calefit; quo facto tubulus aquæ immergitur donec refrigeratione aeris in globulo contenti guttulis aliquibus aquæ sit repletus; deinde iterum supra flammam latiore lampadis cujusdam, vel supra prunas ope forcipis parvæ tenetur, donec aqua in globo incipiat ebullire & vapor impetu erumpat. Hæc ebullitio aliquantulum continuatur, quo facto globulus ab igne removetur & extremitati ejus flamma candelæ admovetur. Refrigerante globulo vapor ab igne rarefactus condensatur, vaporumque egressus paulatim diminuitur, qui postquam plene cessavit in ipso etiam momento extremitas tubuli colliquescit, globulusque hermetice figillatus & ab aere vacuus redditur. An vero hoc modo probe ab aere evacuatus sit experiri quivis potest, si nempe extremitatem tubuli sub mercurio diffingat, totus enim globulus mercurio replebitur si dif-

Si diffraçtio caute sine introitu aeris externi fuerit peracta. Idem etiam sub aqua perfici potest, sed licet summâ curâ peragatur non tamen æque succedet, dum enim aqua globum intrat, aer qui semper in aliqua quantitate aquæ commixtus est ab illa in minutissimis bullulis separatur, quæ postquam coiverunt sub specie bullulæ majoris in globulo apparent. Eodem modo globus ab aere evacuari potest, si tertia, dimidia vel major pars globi aqua repleta desideretur; desiderata enim quantitate aquæ prius impletur, & deinde post ebullitionem aquæ hermetice clauditur. His explicatis ad experimenta pervenio.

Globulum vitreum, cujus diameter unum circiter pollicem æquabat, memorato modo ab aere evacuatum & aqua pluviali fere ad dimidiam partem repletum, die secundo Martij Anni 1721, frigoris rigori exponebam. Aeris temperies in thermometro juxta posito gradu 15° notabatur. Elapso horæ spatium aquam adhuc fluidam in globulo reperiebam, cujus rei causam esse arbitrabar quod aqua nondum bene a frigore esset penetrata; ut autem omnis tolleretur scrupulus globum per totam noctem aeri expositum reliqui. Sequenti die ad horam matutinam quintam aquam adhuc fluidam inveni, & liquor thermometri eundem adhuc notabat gradum: cujus improvisi phænomeni causam aeris absentiae tribuebam. Ut conjecturæ veritas innotesceret diffregi tubuli extremitatem ut spatium vacuum globuli aere repleretur, quo facto tota aquæ massa celerrime tenuissimis glaciei lamellis permiscebatur. Prius quam hujus experimenti repetitio fieret, alio experimento explorare volui an hæ lamellæ glaciales aquæ innaturæ essent; quapropter globum diffregi partemque aliquam glaciei aquæ vitreo poculo contentæ injeci, illamque aquæ innatare vidi.

Dum autem forte oculos admodum brevi temporis intervallo in alium quendam direxeram locum, poculum respiciens totam aquam glacialibus lamellis permixtam cernebam, manente tamen adhuc in interstitiis lamellarum plurimâ aquæ parte fluida. Thermometron huic mixturæ impositum 32^{um} notabat gradum. Hæc phænomena attentius contemplari cupidus, experimentum duobus aliis globulis repetere decrevi: quos præparatos ut supra per horæ spatium aeri externo exposui, liquor autem thermometri interea jam 20^{um} attigerat gradum. Elapso hora aquam in ambobus globulis adhuc fluidam inveni; at postquam vacuum globuli spatium aere iterum repletum erat, citissime etiam aqua (ut prius) lamellis glacialibus permiscebatur, quarum generatio tam subita erat ut eam vix oculis assequi poteram. Et quoniam lamellarum generatio quæ in poculo vitreo erat facta observationem meam effugerat, hinc maxime curiosus eram illarum generationem paulo attentius contemplandi. Priusquam autem globulorum alterum diffringerem, aquam memorato poculo contentam a lamellis glacialibus separavi; quo facto globulum diffregi & glaciem in globo generatam aquæ

Experiments on the freezing of water.

aquæ injeci. Glacies injecta quidem aquæ innatabat, sed lamellarum generatio in poculo frustra a me expectabatur. Ob negotia quædam experimentorum continuationem adveniēti dedicavi nocti. Quæ postquam advenerat, hora undecima tres globulos sævienti gelu exposui. Horum duo ad dimidiam circiter partem aqua erant repleti, residua parte vacua; in tertio vero quarta circiter pars erat vacua. Aeris temperies in thermometro 26^{to} notabatur gradu. Hora quarta matutina eandem aeris temperiem thermometro deprehendi, & aquam in duobus globulis qui tantum pro dimidia parte aqua erant repleti adhuc fluidam inveni: in tertio autem aqua congelata, globus diffractus erat. Glacies minutissimis sed admodum paucis permixta erat bullulis, pelluciditasque ejus maxime perturbata apparebat & confusæ chrySTALLIZATIONI alicujus falis simillima. Hujus experimenti successum infelicem invisibili cuidam fissuræ tribuebam, quâ aer externus introitum invenerat atque ita aquam congelaverat.

Magno adhuc flagrans desiderio lamellarum generationem in poculo vitreo attente contemplandi, vas vitreum e cubiculo in illam afferebam cameram ubi hæc experimenta fiebant; dum autem scalas paucas quæ ad illam ducebant cameram ascendere volebam, deficiebam scalam aliquam pede bene attingere, quo factò aqua vitro contenta ruditer commovebatur, atque eo ipso momento tota ejus massa plurimis permixta apparebat glacialibus lamellis. Hoc casu edoctus sum glaciem in aqua satis frigida agitatione produci posse; cupidus inde eram experimento explorare an aqua etiam in spatio vacuo agitatione congelasceret. Postquam igitur globulum aliquantum agitaveram magna animi voluptate eundem conspexi eventum, simulque judicij errorem agnovi, quod nempe absentis aeris fluiditatem aquæ attribuissem. Interea thermometron indicabat gelu multum languescere, liquor enim jam ad 28^{um} ascenderat gradum; cito igitur manu dissolvi glaciem, globulumque unum iterum aeri exposui, erat enim alter casu diffractus. Relicto globo per dimidium circiter horæ spatium, gelu adhuc magis remittere observavi, thermometri enim liquor jam ad gradum 32^{um} pervenerat. Et quoniam verebar ne remissione frigoris experimenti repetitio vana futura esset si diutius globulus aeri relinqueretur expositus, hinc ipso tempore agitatione globuli aquæ congelationem tentavi; sed licet fortiter agigaretur ne vel minima tamen congelationis apparebant indicia. Cum vero hoc modo omnis spes evanuerat, adhuc experiri volebam an congelatio successura esset si spatium vacuum globuli iterum aere repleretur. Diffracta igitur extremitate tubuli minutissimæ glaciei spiculæ per totam aquæ massam diffusæ generabantur, quæ circumrotatione aquæ superficiem petebant, amœnissimumque spectaculum reflectione luminis ab earum politis superficiebus præbebant.

Observations on the figures of snow.

55

*Observations
on the figures
of snow. By
Dr. Ben.
Langwith,
n. 376. p. 298.
March, &c.
1723.*

XX. Jan. 30. 1723. a little past nine in the morning, weather cold, wind S. W. but not very high, barometer above thirty inches, I saw that pretty phenomenon of the star-like snow; and though upon comparing my observations afterwards with those of Descartes, Dr. Grew, and Mr. Morton, I find I have but little to add upon the subject, yet as I observed the progress of nature in this sort of crystallization with a great deal of pleasure, I hope an account of it will not be disagreeable.

I shall begin with the most simple figures A and B, of which the former is a roundish pellet of ice; the second a small oblong body with parallel sides, and often as fine as a hair. Of this latter kind the flakes of snow chiefly consist; and though they look white to the eye, yet when viewed with a small magnifier or a microscope they appear like so many transparent needles of ice thrown together without any manner of order.

The next figure is C, in which the pellet has shot out six of those small bodies of equal length and set at equal angles: of this kind I saw a considerable number.

The next step in the crystallization is D, in which those bodies are lengthened and have shot out a great many more from their sides, at equal angles, but unequal lengths, as growing continually shorter and shorter 'till they terminate in a point: I measured some of these and found them to be about one quarter of an inch in breadth. I saw but very few of them in perfection, for the collateral shoots were so exquisitely fine as to be liable to be broken in their fall, or confounded together by the least degree of heat.

Of the next kind, E, I saw a very great number, which being examined by the microscope plainly appeared to be only the former in disorder. The edges of these were in general very irregular, but some of them happened to be so indented as to look like the jagged leaves of plants.

The next kind, F, had twelve points regularly disposed, and probably might consist of two of the former so joined together as to cut their angles equally.

Perhaps also those Mr. Morton describes as consisting of radij which instead of terminating in a point grow bigger as they advance from the centre, might be formed from two of the kind, C, so joined at the centre as to cut each other's angles unequally; for in the progress of the crystallization these radij would quickly unite.

Lastly, that sort which Descartes compares to roses, and of which he has given a figure in his treatise of meteors, may be nothing but the kind E, when the points are rounded off by being gently thawed.

I propose these things only by way of conjecture; because as the small drops of water may be impregnated with very different particles in the air, it is not easy to determine whether these figures may

Of the meteor called Ignis Fatuus.

may not be the result of a crystallization quite different from the former.

I saw but very few figures of twelve points, and those mostly imperfect in one respect or other.

*Of the meteor
called Ignis
Fatuus. By
Mr. W.
Derham,
n 411. p. 204.
Octob. &c.
1729.*

XXI. 1. It is the opinion of diverse skilful naturalists, particularly Mr. Fr. Willughby and Mr. Ray, that the ignes fatui are only the shining of a great number of the male-glowworms in England, or of the pyraustæ in Italy flying together, but I have good reason to think that insects are not concerned in the ignes fatui from the following observations; the first I made myself, and the others I received from Italy by the favour of Sir Tho. Derham.

In a valley between rocky hills, which I suspect might contain minerals, in some boggy ground near the bottom of those hills, seeing one in a calm, dark Night, by gentle approaches I got within two or three yards of it and viewed it with all the care I possibly could. I found it frisking about a dead thistle which stood in the field, 'till a small motion of the air, caused only by my approaching it, made it skip to another place, and thence to another and another.

The male-glowworms I know emit their shining light as they fly, in order to discover and woo the females; but I never observed them fly together in so great numbers as to make a light equal to an ignis fatuus. And I was so near it, that had it been the shining of glowworms, I must have seen it in little distinct spots of light; but it was one continuous body of light, so that in my opinion it was a fired vapour.

*By Dr. G. B.
Beccari, to
Sir Tho.
Derham,
ibid. p. 206.*

2. The observations which Sir T. Derham procured for me in Italy, are contained in the following letter written to him by Dr. Giac. Barth. Beccari.

What I now offer concerning these fiery appearances, is the result of many conversations with several experienced travellers, men of learning and reputation, whose sincerity I had no reason to mistrust. For my own satisfaction I have made it my business to speak with such as travelled much in the mountains, and with others that observed them in plains, on purpose to see whether the difference of the place made any in the appearance. I find upon the whole that they are pretty common in all the territory of Bologna. To begin with the plains, they are very frequently observed there; the country people call them Cularsi, perhaps from some fancied similitude to those birds, and because they look upon them as birds, the belly and other parts of which are resplendent like our shining flies. They are most frequent in watry and morassy ground, and there are some places where one may be almost sure of them every dark night. In the fields near the bridge Della Calcarata, in a common belonging to the parish of S. Maria in dono, north of Bologna, one of these fiery appearances is very often observed to move a-cross the fields coming from another bridge called Della fossa quadra. There is another of them

them in the fields of Bagnara almost east of Bologna, which scarce ever fails to appear in dark nights, particularly when it rains or snows, as also in cold and frosty weather. Both these are very large; and I am assured, that sometimes their light is equal to that of one of our ordinary faggots, and that it is scarce ever less than that of the links which our country people make of hemp-stalks to use when they travel at night. That at Bagnara appeared not long since to a gentleman of my acquaintance as he was travelling that way; it kept him company for a mile or better, constantly moving before him and casting a stronger light on the road than the link he had with him.

I believe there may be many more in other plains as large as two, though at present I have not been able to get certain information of any. Lesser ones there appear many, some of them giving as much light as a lighted torch, and some no bigger than the flame of a common candle. Of these I am assured a good many have been seen in the fields of Barisella. All of them resemble both in colour and light a flame strong enough to reflect a lustre upon neighbouring objects all round. They are continually in motion, but this motion is various and uncertain. Sometimes they rise up, at others they sink, disappear of a sudden, and appear again in an instant in some other place. Commonly they keep hovering about six foot from the ground. As they differ in largeness so they do in figure, spreading sometimes pretty wide, and then again contracting themselves. Sometimes breaking into two, and soon after joining again; sometimes floating like waves, and dropping as it were sparks of fire. I have been assured that there is not a dark night all the year round that they do not appear. And in the middle of the winter, when the weather is very cold and the ground covered with snow, they are observed more frequently than in the hottest summer. The gentleman who obliged me with an account of that at Bagnara told me, that if I had a mind to see it my self I might be sure of finding it if I went thither in very cold weather. Nor doth either rain or snow in any wise hinder their appearance; on the contrary, they are more frequently observed and cast a stronger light in rainy and wet weather. This last circumstance indeed hath been taken notice of by some writers, and among the rest, if I remember right, by the learned Gassendi. Neither doth the wind much hurt them, though one should think that if it was a burning substance like common fire it should either be dissipated in windy weather or extinguished by rain. But since they do not receive any damage from wet weather, and since, on the other hand, it hath never been observed that any thing was thereby set on fire, though they must needs in their moving to and fro meet with many combustible substances, it may be very reasonably inferred that they have some resemblance to

Of the meteor called Ignis Fatuus.

that sort of phosphorus which indeed shines in the dark but doth not burn any thing like common fire. Nor is there any thing extraordinary in this, any more than in other fiery appearances which I am informed are likewise pretty common, and agree with the ignes fatui in having only the splendor and appearance of fire without the quality of burning, but differ from them in many other particulars. Such a phaenomenon was observed by a clergy-man of Bologna one summer's evening near some country houses. The flame seemed to him so strong that he called aloud to put it out, for fear it should reach a hay-loft and a heap of hemp that lay not far from it; but when he came to the very place where he had first seen the flame, he could not perceive the least footstep of fire, though there lay a good deal of combustible stuff all thereabouts, which would have easily taken fire if there had been any thing of an actual flame upon the spot. The same gentleman told me that in a very dry summer he observed in the middle of some other fields of his own, for several evenings together, a pretty considerable flame on the ground nearly in the same place, and that having resolved to go and take a nearer view of it the next evening, it did not appear for that time; that, however, he went to the place where he had before seen it and sat himself down on the ground, but could not observe the least mark that any fire or flame had been in that spot, nor feel any heat in the ground any more than in other places; only he saw some slight flames arising out of the earth hard by, which disappeared as soon as they came into the open air. It is well known to such as travel on horseback at the beginning of the night in the heat of summer, that when they traverse the dry beds of rivers and with their horses feet break those sandy grounds that have been all day long strongly heated by the sun, there rise up some bluish flames which very often fright the horses. This phaenomenon is most common in those places where the water hath left behind a kind of a chalky sediment or fat earth, which drying afterwards forms a thick hard crust. So likewise if in the heat of summer you travel in dark nights, either on horseback or on foot, over the burnt-up ground of some fields, you shall see flames break out of the ground almost at every step. All these fires and flames have indeed the light and shining, but not the burning quality of fire. And this is the only thing they have in common with the ignes fatui, differing very much in other respects, particularly in not appearing at all seasons of the year, and most frequently in the winter, as the others do. Thus far what I could learn concerning the Will-with-a-whisp, as it hath been observed in the plains. As to the appearance of this phaenomenon in mountainous parts, by what I have hitherto been able to learn they differ in nothing else but in largeness; and all those I conversed with that saw them in the mountains agree that they never observed any larger than the flame of an ordinary candle. Nor do those

those that live in the mountains call them Cularfi, which name is perhaps used only by the country people in the plains for those large ones above described. The difference of the air and soil may, for ought I know, contribute a great deal towards the different size of these appearances; at least all that I can offer material at present with regard to their largeness is, that those grounds where we observe the largest fires, as at Bagnara, are what they here call strong ground (*terreni forti*) being a hard chalky and clay soil, which will harbour the water a long while, and is afterwards in hot weather very apt to break into large cracks and fissures; whereas on the contrary, those soils in the mountains where they observe the small fires are what they call soft or sweet ground (*terreni dolci*) being generally sandy and of a more loose contexture, which do not keep the water so long as the others. Of that sort also is the soil in the above-mentioned plains of Barisella, where about 7 or 8 years since they observed a good number of the smallest *ignes fatui* in the fields, within the compass of about three miles. According to the best informations I have hitherto been able to procure, these lights are great friends to brooks and rivers, being frequently observed along the banks of them, perhaps because the air carries them thither more readily than any where else. In all other particulars, as in their motion, the manner of their appearance, their disappearing, sometimes very suddenly, their light, the height they rise to, and their not being affected either by rainy or cold weather, they are the very same with the Cularfi above described, or the large Will-with-a-whisp observed in the plains.

I cannot forbear adding the following curious and singular observation made by a very accurate and knowing gentleman. Travelling sometime in March, between 8 and 9 in the evening, in a mountainous road not far from our Lady del farso about ten miles south of Bologna, as he approached a certain river called Rioverde he perceived a light which shone very strongly upon some stones that lay on the banks. It seemed to be about two foot above the stones and not far from the water of the river. In figure and largeness it had the appearance of a parallelopiped, somewhat above a Bolognese foot in length, and about half a foot high, its longest side lying parallel to the horizon: its light was very strong, insomuch that he could very plainly distinguish by it part of a neighbouring hedge and the water in the river; only in the east corner of it the light was pretty faint and the square figure less perfect, as if cut off or darkned by the segment of a circle. The gentleman's curiosity tempted him to examine it a little nearer; in order to which he advanced gently towards the place, but was surprized to find that insensibly it changed from a bright red to a yellowish, and then to a pale colour, in proportion as he drew nearer, and that when he came to the place it self it was quite vanished. Upon this he stepped back, and not only saw it again but

found that the farther he went from it the stronger and brighter it grew; nor could he upon narrowly viewing the place where this fiery appearance was, perceive the least blackness or smell, or any mark of an actual fire. The same observation was confirmed to me by another gentleman who frequently travels that way, and who assured me that he had seen the very same light five or six different times in spring and autumn, and that he had always observed it in the very same shape and the same place, which to me seems very difficult to be accounted for. He told me farther that once he took particular notice of its coming out of a neighbouring place and settling it self into the figure above described. How it comes to pass that the nearer one approaches to these or the like fiery appearances the fainter they grow, 'till at last they disappear totally, I own my self at a loss; but I cannot help thinking that there is something in it analogous to what we observe in fogs and clouds, which at a distance have indeed the appearance of very thick bodies, but are found more rare as one gets into them. Nor is it improbable, as they must be something very thin and subtle, that upon the approach of grosser bodies with their atmospheres, they are actually driven away.

This is the substance of what I have been able to gather from several accounts relating to the ignes fatui; but as to the causes of them I will not pretend to assign any: I shall only add that all who ever saw any of these appearances agree that they cast a light quite different from that of the shining flies; and if you reflect on the several circumstances above related, I believe you will find that they are not easily, if at all to be solved by that hypothesis.

*A description
of the great
meteor seen
March 6.*

171 $\frac{1}{2}$. By

Mr. Rog.

Cotes to Dr.

R. Danye.

n. 365. p. 66.

May, &c.

1720.

Vid. Vol. IV.

P. 11. p. 138.

XXII. 1. The appearance of the meteor was very nearly the same with us here at Cambridge as with you in Yorkshire, excepting that the triangular streams of light were not so permanent as you seem to describe them, and the point to which they all converged was distant from the zenith about 20 degrees; its azimuth lying between the south and the east at about 10 degrees from the south, towards which point of the compass the wind tended. The position of this point of convergence may be more accurately determined if there be occasion: for at a quarter after 7, when the appearance to us was in its greatest perfection, it lay nearly in the middle between the two bright stars in the heads of Castor and Pollux. I am told that some streams were seen to shoot forth immediately after sun-set, and that they did not perfectly cease 'till about three or four in the morning.

It was after 7 before I had notice of this uncommon sight. At first I saw only two or three of the triangular streams towards the north and north-west: these were not of long duration, but were succeeded by others which appeared and vanished again by turns, arising from and ascending up to places in the heavens of very different altitudes above the horizon. From the time I began to view them they con-

tinued

tinued to ascend more and more copiously, being propagated still further and further from the north towards the west and east, and directed always to the heads of Gemini, 'till at length when they seemed almost to meet at the point of convergence, they began to ascend up towards it from the southern parts also and all around it; insomuch that at a quarter after 7 we had a perfect canopy of rays over us. The bottom of this canopy did no where reach down to the horizon; for near the north, where it descended the most, its altitude was about 10 or 15 degrees; and near the south, where it descended the least, its altitude was about 40 degrees. It remained in this state about 2 minutes, during which time we saw several colours, some fainter and more permanent, others brighter but quickly vanishing. Thus in the west I observed the rays to be tinged for some considerable time with an obscure and heavy red; and in one of the brightest streams at another time there suddenly broke out a very vivid red which was instantly and gradually succeeded by the other prismatic colours all vanishing in about a second of time. These colours affected the sense so strongly that I thought them to be more intense than those of the brightest rainbow I had ever seen. A small time before the appearance lost its perfection we were surprized to observe a shaking and trembling of the streams chiefly in their upper parts, during which their convergence was confounded, and the whole heaven seemed to be in a convulsion. At the same time I could perceive waves of light towards the north which moved upwards, and in their motion crossed the streams lying parallel to the horizon. These waves were different from those broad ones which you mention and which I also took notice of. Their breadth seemed to be about a degree, their length about 90 degrees; and I can compare them to nothing better than to those slender waves upon the surface of stagnant water which are made by casting in a small stone.

About seven or eight years ago I happened to see a meteor which it will be of use to describe to you. Along the horizon in the north there lay a white, luminous and seemingly dense matter in the form of a cloud represented by a b c d; the length of it, a b, was about 10 or 15 degrees. From this there arose directly upwards pointed streams of the like luminous and white matter, which yet did not appear in any part of it to be so dense as the former, and grew gradually more and more rare in its upper parts so as to vanish almost insensibly at the points. There was some little difference in the height of these streams, but they generally ascended up to about 4 degrees above the horizon. They were very numerous and contiguous to each other, and seemed to be composed of very slender parallel filaments or rays. This was the common appearance, and the only remarkable thing which I farther observed was, that sometimes a fire or flame would break out in the cloud, a b c d, and move along it in a direction parallel to the horizon:

Fig. 3.

Fig. 9.

horizon : and during this motion a pointed stream directly over the fire seemed to run along with it, and to pass by the other more fixed streams to which it always kept it self parallel.

I am persuaded that the late appearance was of the same kind with this which I have now been describing. For let *AB* represent the plane of the horizon, *C* the place of the spectator, *E F* a fund of vapours or exhalations at a considerable height above us, diffused every way into a large and spacious plane parallel to the horizon. This fund of mixt matter by fermentation will emit streams from it self, such as *EG*, *FH*, &c. which, if the wind be perfectly still, will ascend perpendicularly upwards; if it be boisterous and irregular, they will be blended and confounded together; but if it be very gentle and uniform, as it was at the time of our appearance, they will be inclined towards the point of the horizon which is opposite to that from which the wind blows. Now if *ADB* represent the concave of the heavens and a line *CD* be drawn parallel to the columns *EG*, *FH*, &c. 'tis certain by the rules of perspective that these columns will appear upon that concave to converge all around towards the point *D*: thus the column *EG* will seem to arise from the point *e*, to ascend up to *g*, and to take up the space *eg*; and in like manner the arch *fh* will be the projection of the column *FH*. From hence it is evident that the reason why the triangular streams ascended at first only from the northern parts of the heavens was this: the fund of matter *E F* was not yet arrived by its motion to the line *CD*. After it had passed that line it is plain they must appear to ascend from all quarters. A great number of columns being therefore disposed to emit light at the same time, caused that perfect canopy which I described above. The reason why that canopy descended lower in the north than in the south was this; the shining columns which had not yet passed the line *CD* were more numerous and more remote from it than those which had passed it: for if the point *E* be farther distant from *CD* than the point *F*, the arch *Ae* must needs be less than the arch *Bf*. An irregular gust of wind blowing upon and shaking the columns was (I suppose) the cause of that trembling which appeared in the triangular streams, and the cause also which destroyed that fine appearance of the canopy. The slender circular waves seen at the same time might also be explained from the same cause. I need not detain you any longer by endeavouring to make out some other particulars of this unusual appearance. However I will mention a very easy contrivance by which the thing may be tolerably well represented to view. Take a hoop and round about it fasten several streight sticks parallel to each other, but all inclined to the plane of the hoop; hold this plane parallel to the horizon, and in that posture move it with the sticks over a candle; the shadows of the sticks upon the ceiling of your room will converge to a point not directly over the candle (as they

they would have done, had the sticks been perpendicular to the plane of the hoop) but to the point in which a line drawn from the candle parallel to the sticks shall intersect the plane of the ceiling.

2. It began about 10 a Clock, but nothing very remarkable appeared 'till about half an hour after 11, when I was called out to see it by the servants who had been looking at it about half a quarter of an hour, and told me it looked just like fire. But it appeared first to me in long streams of light of a round body, as at A, and very bright, though some were coloured, as at A a. They came before the wind which was then west, as near as I could guess, there not being a cloud in the sky, and the brightest moon I have known. We had rain about 5, but at 6 the night was clear. The Streams of light A A moved very slow (there being little wind) but as they moved they joined, and swelling out in the middle formed themselves into the figure *bb* B, continuing to advance slowly in that shape for about a minute, when the two ends *bb* approaching each other, as described by the pricked lines, the advanced part B suddenly and with great swiftness ran back, and joining itself with the ends *bb* formed the figure C, quivering in the upper part and darting down perpendicularly in sharp points, as at DDD; and its colour from a bright light changed into those of a rain-bow, but much fainter. It continued thus about a minute, and then the sharp points DDD gathering themselves up into C, it changed again into a square sheet of light, as at E, and swelled out at F, as before at B; and advancing leisurely repeated the same scene as before, 'till it seemed at a great distance to disperse itself into small thin light clouds; though it is probable that to those who saw it in a like situation, as it travelled, it might make the same appearance as it did to me. I was very particular in observing it, and the next morning drew it, and I think very exactly. I should have continued longer to look at it, though I staid above a quarter of an hour, but it was excessive cold. The beginning of it was very like the Aurora Borealis, which has been very frequent here this winter.

3. Erant solito plures phasmatum tractus, arcus nimirum albicantes & reliquo cœlo (sereno utique ac tranquillo) lucidiôres, quatuor ad minimum aut tres, mediocribus tenebrarum intervallis distincti, & unus supra alterum positi. Quod autem rarissimum adspectuque jucundum, dictorum arcuum distantie sub ipsa Cynosura maximæ (infra quam supremus quidem ultra viginti & sex gradus non consistebat, quippe per quem stella Ursæ majoris Dubbe leviter subinde transparebat) versus horizontem utrinque sensim decresebant, donec illi tandem in ipsis orientis occidentisque cardinibus mutuo sese interfecarent, haud secus quam in artificiali globo meridiani ad polos æquatoris convergere cernuntur. Candidi isti arcus seu semicirculi maximam partem ex striis distinctis & ad horizontem normalibus constabant.

A luminous appearance in the air at Dublin, Jan. 12. 1748.
By Ph. Percival, Esq.
n. 364 p. 21.
Jan. &c.
1720.
Fig. 10.

Fig. 11.

Fig. 12.

An Aurora Borealis observed near Upsal, Sept. 20. 1717.
By E. J. Burman.
n. 385. p. 175.
Oct. &c.
1724.

constabant, præsertim in summitate, vel sub ipso septentrione; ad latera lux debilior conspiciebatur ac subobscura.

Striarum geminus erat motus, horizontalis unus, alter perpendicularis: hic minor longe & tardior, ut vix circulem arcum formam turbaret; ille varius simul atque celerrimus, ab oriente in occidentem, & retro. Quoties autem striæ plures, quod sæpius accidebat, a contrariis venientes plagis sibi invicem occurrebant, sive id in medio arcu, sive alibi fieret; toties, quasi ex illa radiorum mixtura seu multiplici interfectione proveniens colorum pulcherrima apparebat varietas, & quidem ordine prorsus eodem atque in prismatico vitreo, explicatis solique obversis avium minorum pennis, aliisque corporibus similibus colores produci solent.

* *vid. supra*
p. 60.

Hinc vero dari occasio poterit adhuc de opticis phænomeni rationibus, cum Cartesio de meteoris cap. vij. §. 18. cogitandi; sed neque tamen ideo subtiliori materiæ sulphuræ in regione aeris inferiori accensæ omnem denegari posse locum existimamus. Ipsi enim alias sæpius, præsertim in chasmate an. 1716. d. 17 Martij * heic longe illustriori quam in Anglia, Gallia, Germania, alibi, per totam noctem viso, colores multo plures, necnon susurros & sibilos, quales excitari a focali flamma solent, observavimus. Forsan autem duo diversa statuere luminis borealis genera oportet: unum meteoron igneum ab effluviis & exhalationibus; alterum mere parastaticum, ex diversimoda solarium radiorum refractione & reflexione, sive in glacialibus quibusdam lamellis, stellulisve atmosphæræ regionem excellorem occupantibus facta, sive etiam in maribus quibusdam ad septentrionem, indeque nobis ex nubibus communicata, ortum. Certe posterius singulari experimento illustrari posse videtur, quod occasione jam descripti phasmatis (cui tamen simile vidimus an. 1716. in Februario hora vespertina 9. ex duobus ejusmodi arcubus semicircularibus, sed minus striatis & supra borealem horizontis plagam elevationibus, constans) inventum factumque, huc redit.

Si lamina sumatur stannea longitudinis latitudinisque arbitrariæ, eademque acuto & fortiori cultro, uno ductu secundum longitudinem universam, donec tota striata facta fuerit, rasa, manu ita teneatur, ut ejus planum cum lucente candela & obscuro pariete tabulæ æquales faciat angulos; deinde autem variis modis incurvetur & torqueatur, ipsam nunc concavam nunc convexam parieti vel tabulæ obvertendo, tardius ad lubitum aut celerius: phasmata supra recensitis admodum similia spectaculo non injucundo repræsentabuntur.

Quid si utriusque generis lumen forte aliquando una existere, atque unum cum altero coincidere dicamus, ut neutrum alterius causa sit aut effectus, sed ambo ad noctem illuminandam terroremque spectantibus incutiendum concurrant? Quemadmodum enim sæpissime quidem lumen horizontale, zonas videlicet candentes, nunc nudas (imo per ipsum fere zenith transeuntes, quas cum galaxia, utut non
parum

parum latiori, ob similitudinem vulgus confundere solet) nunc columnis, pyramidibus inversis aliisque figuris variis stipatas, sed citra omne aeris, ut ita dicam, incendium; ita nec raro hoc sine illis vel antecedentibus vel concomitantibus, apparentiis distincte notatis, vidimus: quamvis etiam e regione quadam cœli, nude primum candente, tandem ferventissimas faces, sive per solis radios in glacialibus Oceani partibus, ceu in speculis quibusdam causticis, reflexos, sive alio quocunque modo accensas, ad zenith & super totum nonnunquam hemisphærium evolasse fatendum sit.

Sed genuinas verasque phænomeni hujus admirandi causas vix cuiquam certo invenire prius licet, quam plurimarum in diversis terræ locis unâ habitarum observationum rite institui queat comparatio; unde ante omnia constet, num lumen istud in remotioribus etiam locis sub eodem altitudinis angulo conspiciatur; num quod heic horizonti parallelum, alibi verticale sit, & id genus alia; verbo, utrum unus idemque sit arcus qui in diversis locis conspicitur, an quemadmodum in iride, ita quoque heic, quot in terra spectatores, tot arcus in cœlo.

4. Sept. 5. 1718. circa hor. x. phænomenon delineatum fig. 13. observatum fuit Lennæ regis, in puncto boreali.

Sept. 6. circa horas viii & x. perplures luminis columnæ similes supradescriptis (aa) observabantur, non æque lucidæ ac pyramides nocte præcedente observatæ quæ ferebantur versus orientem, hæ vero ad occidentem.

Sept. 11. perplures istiusmodi columnæ iterum conspiciuntur cum motu occidentali.

Sept. 13. circa horam xi. aurora borealis lucidior ac altior fuit longioribusque pyramidibus adornata quam adhuc observata fuerat. Adeo lucebat hâc nocte ut characteres in libro legerentur.

Oct. 11. circa horas x & xi. Aurora borealis lucidior quam unquam fuit ac coruscationibus pyramidalibus interspersis, haud multum abfimilis phænomeno prius observato Sept. 5. Lumine iterum ita splendente, ut legere liceret.

Dec. 19. circa horas viii & ix. Hâc nocte visi sunt cum aurorâ boreali perplures lucis radii, e nube veluti nigrâ exorientes; revera autem non fuisse nubem exinde patet quia stellæ per illam clare videbantur. Quid vero aliud fuerit haud facile est dictu. Sed quod præcipue notavimus, fuit motus horum luminum fane mirabilis. Hos radios observavimus in statu semper mobili, positiones suas seu loca perpetuo mutantés; cursum suum modo hâc, modo illâc, rursus, prorsum dirigebant, & interdum alii ex aliis eâdem viâ singulatim progressi sunt, & aliquandiu sibi invicem collisione mutuâ impingebant cum tremulo ac vibrante motu, & celeritate fere incredibili. Radii quidam observati sunt usque ad zenith se porrigentes. Visa est sæpe lux se in acervum collegisse, atque ita mirum exhibuisse fulgorem coloribus iridis

Fig. 13.
Observations
of the Aurora
Borealis at
Lynn Regis in
Norfolk, from
Sept. 5. 1718.
to Dec. 23.
1722. By
Mr. W.
Raistrick.
n. 376. p. 300.
March, &c.
1727.

tinctum, & iterum visa est se dilatasse. Luna hac nocte lucide splendebat.

Martii 12. 171 $\frac{3}{4}$. circa horas x & xi. Aurora borealis rursus observabatur.

Fig. 14.

Mart. 17. iterum visa est aurora borealis cum radiationibus variis obliquis, secundum figuram 14.

Octob. 26. 1719. hac nocte etiam visa est circa horas vii & viii.

Nov. 9. 1719. Jan. ult. 17 $\frac{1}{2}$. hac nocte ab hora septima usque ad decimam aurora borealis visa est altior quam unquam antehac observata fuit, per dimidium coeli ab oriente usque ad occidentem fere obducta, coruscationibus variis interspersis, adeoque lucebat ut characteres in libro perquam distincte videri possent.

Sept. 17. 1720.

Jan. 6. 172 $\frac{1}{2}$. circa horas vii & viii. visa est iterum aurora borealis cum coruscationibus pyramidalibus undique a zenith, veluti centro, obductis, imaginem exhibentibus pæne instar umbellæ.

Jan. 12. 172 $\frac{1}{2}$.

Sept. 11. 1721. circa hor. ix.

Sept. 5. 1722. ab hora decima ad sesquidecimam.

Octob. 3. circa hor. ix.

Octob. 4. circa hor. x.

Dec. 23. 1722. circa hor. viii.

5. Feb. 19, 172 $\frac{3}{4}$. hora seque decima.

Martii 15. 172 $\frac{3}{4}$. ab hora octava, ad mediam usque noctem.

Aug. 20. 1723.

Oct. 20. 1723. ab hora sexta, ad mediam noctem.

Sept. 26. 1725. aurora borealis visa est ab hora septima ad horam decimam, cum radiationibus variis.

Oct. 3. 1726. per totam noctem.

Item Oct. 4. 1726.

Itemque Oct. 8. 1726. per totam noctem. Mirum fanè phænomenon, sed ab aliis jam accurate descriptum.

Oct. 26. 1726. circa horam decimam.

Mart. 3. 172 $\frac{3}{4}$. ab hora octava, ad mediam noctem. Aurora hac nocte (ut mihi videbatur) longè mirabilior fuit illâ Oct. 8; & credo equidem, nullatenus discrepavit (secundum descriptiones quas habemus) ab illo memorabili phænomeno sexto Martii, 17 $\frac{1}{2}$.

Item Martii 5. 172 $\frac{3}{4}$.

6. Feb. 6. 172 $\frac{1}{2}$. The air was all day as it had been for some time before very clear and sharp: about half an hour past four in the evening some flying clouds appeared, and the sky was tinged with a very unusual yellowish colour, which perhaps might be reflected from a great quantity of snow that soon after fell for near a quarter of an hour. However that be, I am willing to date the beginning of the ensuing phænomena from the first appearance of this uncommon light.

About

Continued
from Feb. 15.
1722. to
March 5.
172 $\frac{3}{4}$. By
the same.
n. 398. p. 255.
Apr. &c.
1727.

An Aurora
Borealis ob-
served at
Dublin Feb. 6.
172 $\frac{1}{2}$. By
Mr. J. W.
n. 368. p. 180.
May, &c.
1721.

About a quarter past six a thin vapour, which was as yet very ill defined and in all appearance resembled an exceeding black cloud, had fixed it self in the northern hemisphere; its edges were tinged with a reddish yellow, that by degrees as it approached the vertex grew more dilute 'till at last it ended in a faint whiteness. That in reality it was no cloud, but only a vapour exceeding pure and limpid, was manifest, because several of the fixed stars shone through it without having their light in any degree effaced. In the midst of this dark basis, about half an hour past six, a lucid area shewed it self due N. E. about 35 deg. above the horizon, and in less than a minute from the time I first discovered it emitted a very large pyramidal stream of shining vapour, which with an incredible swiftness ascended obliquely towards S. S. W. so as to leave the zenith considerably to the westward, and very soon after, about the same place, six others arose at the same instant almost to the zenith. From this time 'till 48 minutes past six we had repeated projections of these lucid rays without any order as to time, place or magnitude. They did not only arise from behind the dark basis, but sometimes as it were out of the pure sky; and though some of them continued visible more than a minute, yet the greater part of them only just shewed themselves and died away. I had now got to the top of a convenient observatory, where (though destitute of instruments) I had a free prospect of the horizon; and in company of another gentleman fixed my self with great attention to expect the ensuing phases of this phaenomenon.

About 6 h. 55 m. between N. W. by N. and W. N. W. we found the representation of a very bright crepusculum, such as that which appears about 20 minutes after sun-set; from which arose several very large beams of light, not exactly erect towards the vertex, but somewhat declining to the south; among these one which arose about N. W. and in three or four seconds passed over 50 or 60 degrees of a great circle, was above all others that had preceded the most splendid: its sides were inclined to each other with an angle of about 8 or 10 degrees, and were tinged with a brisk lively red, which by degrees as it approached the axis became more intense and dirty: on the other hand receding from the axis its colour was a pale yellow that soon lost it self in a faint whiteness.

From this time no moment passed without such variety of different phases that it was impossible for the eye of any single person to pursue it through the suddenness of its alterations. While some of the lucid beams appeared fixed, as it were, among the stars, others moved slowly from east to west, by which they seemed to meet each other, sometimes to recede from each other, and sometimes by a kind of apposition great ones were produced from others of an inferior order.

The lucid area which I first discovered in the N. E. had now formed it self into a parallelogram, whose upper and lower edges were 5

or 6 degrees distant from each other and nearly parallel to the horizon: in this, as if behind a curtain, vast waves of light, whose extremities did not reach the periphery of the dark basis, seemed to meet and pervade each other; at other times, while some of 'em with a remarkable velocity moved eastward, others as if behind them would fly towards the west; by which variety of different motions as often as any interval passed between the collision of these erect waves a beautiful undulation was produced, and its pulses by the adjoining parts of the fluid were propagated to a vast distance.

While we stood amazed at this surprizing sight the axis of the coloured pyramid which arose in the N. W. had moved considerably toward the west, and at 7 h. 25 m. was about 23 or 25 degrees to the north of Venus. The dark basis of this meteor had now extended almost to the east point of the horizon, and at half an hour past seven between E. N. E. and E. by N. several large columns ascended in an instant to the zenith; the most eastward whereof was remarkably convex toward the south and tinged with a pale red, as were most of those which ascended with it. They were met by others that arose at the same time between the north and west, and in the zenith formed a vast collection of vapour that pretty much resembled smoke enlightened by the sun's beams; its waves reflected a brisk, lively red colour, and in some places a pale yellow; they rolled indifferently any way; and in little more than a minute, when the first efforts of their congress were spent and all seemed fixed and serene, the corona projected several small rays which with a slow uniform velocity descended between W. by N. and N. W. soon after which it died away.

We had not much time to lament the absence of our spectrum; for at 7 h. 40 m. several other striæ were discharged from behind the dark basis, which intersecting with others that at the same time arose about the east and west points formed in the zenith, or rather 6 or 8 degrees to the south thereof, a second much more elegant and surprizing than the former, and indeed than any thing that had yet appeared: it was not only tinged with different orders of red and yellow, but also with blue and violet, the last of which by a mixture with the white light appeared faint and inclined to purple. Though the vapour of which this and the preceding corona were formed was so exceeding thin and pure that several of the fixed stars were visible through it, yet it reflected a light so copious that I could thereby perfectly distinguish the time of night by a small gold watch. While we were thus delighted our phænomenon ejected four or five large columns toward the N. W. (besides others towards the south) which appeared pointed at the top and their sides inclined to each other with an angle of 5 or 6 degrees. When their bases were extended about 30 or 35 degrees from the vertex, the lower parts of two or three of 'em broke,

as it were, by the mere weight of the vapour, separated from the upper and descended with a slow motion in the form of truncate cones: they were gradually followed by their upper parts and in about a minute were lost in a large body of light that was settled between the N. W. by N. and W. N. W. The corona, as if exhausted by these great discharges, became immediately more dilute and languid, its lively colours faded and were succeeded by a whitish vibrating light that in less than two minutes intirely disappeared.

The dark vapour which continued to possess the polar regions had now extended it self from the east to the N. W. by N. point of the horizon, and was formed in a large segment of a circle whose center was about 20 degrees below the horizon; its upper edge was tinged with a pale red which was soon lost in a florid yellow, and this again as it approached the zenith became more effete and languid. In this dark segment several lucid areas frequently discovered themselves, with a vibrating light which instantly disappeared, as if a curtain were drawn over them; and from it rays of very different magnitudes continued to ascend without any uniformity as to time and place, 'till 48 or 49 minutes past seven, when a third corona very little, if at all, inferior to the preceding ones, either in the variety of its colours or in the quantity of light it emitted, was formed in the zenith. As the preceding were both produced by the northern striæ, so this was augmented by two or three large ones that arose due south out of the pure sky, and were in all probability part of the vapour which had been projected beyond the zenith, or which had subsided from the two former: they caused the vapour of which this image was composed to move with great violence in different directions, not unlike waves of smoke confined in a reverberating furnace; this motion being abated the vapour acquired a kind of stagnation, in which state it continued but a very short time before it projected several lucid beams, (an inevitable fore-runner of its approaching dissolution) between the north and west, and soon after, pardon the levity of the expression, *Nocti se immiscuit atræ*.

About this time the great beam which arose in the N. W. and had preserved its colours in their original beauty for more than three quarters of an hour began to fade, and at 7 h. 53 m. was absorbed in a vast body of light which seemed fixed in that part of the horizon: it had moved in that time 15 or 20 degrees to the westward of the place from whence it arose. The impetus of the vapour being now pretty much abated we had nothing extraordinary but successive discharges of pointed rays between the N. W. and E. N. E. without any order or uniformity as to time or place; setting aside these there was very little difference in the general face of affairs for 20 minutes; neither had we much reason to hope for any, because the severity of the cold was such that it obliged us to remove to a better climate, and by that means we unfortunately lost the ensuing phases of our dying meteor.

7. Feb.

.... at Cruwys
 Merghard in
 Devon. By
 Sam. Cruwys
 Esq; ibid.
 p. 186.

7. Feb. 6. 1727. a little before 7 in the evening there arose out of the north, or a little towards the east, a bright crepusculum which soon spread it self a great way through the northern part of the hemisphere. About 7, when I first saw it, it began to leave behind it at due north, or a few degrees to the east, part of a very clear sky (which looked like a black cloud, but that the stars shone in it clearly) being a segment of a circle, into which figure the crepusculum, or expanded body of lucid vapour, had now formed its upper limb also, making a kind of broad iris terminated at each end by the horizon.

All this while the streaming lights appeared in great variety as to figure, place, magnitude and colour, but for the most part redder, especially towards the west, than the crepusculum it self out of which they seemed to be formed, and though the greatest appearances had generally been within 20 degrees of the north on each side, yet at due N. W. there were very many considerable ones.

About 8 this crepusculum, which had been constantly, though slowly, carried further from the north, had with the upper part of its outer limb reached to about 10 or 12 degrees beyond the pole-star towards the zenith, being now above 30 deg. broad, with a circular segment of black clear sky to the north of about 25 deg. when the whole crepusculum or vapour was all suddenly formed into aggregate bodies like cones, and made one of the most pleasing appearances that perhaps has been seen of this kind. The bases of the cones seemed to rest on the upper limb of the segment of clear sky (which was extended near 60 deg. on each side the N.) and the vertices of the cones pointing all towards the zenith approached within a few degrees of it, and terminating there formed the greatest part of a semicircle inclosed, as it were, with golden pallisadoes, which shining all at once as bright almost as flame and being of a prodigious length and number exhibited a most agreeable spectacle.

This last phænomenon convinced us that these cones were collections of the very same particles whereof the crepusculum had consisted: because when it appeared every where alike and equal the great stars shined through it but very faintly; whereas afterwards those stars that remained between the cones suddenly appeared very bright, whilst those that were covered by them could hardly be perceived: and indeed all the streaming lights this evening seemed to flow from this crepusculum downwards as from a fountain or store, and not to arise from the horizon, few approaching it nearer than 10 degrees, and many not within 20 or 30 deg.

After this fine appearance had continued about two minutes the matter seemed to be exhausted and the scene almost at an end, the streaming shining lights being mostly extinguished, and the remaining parts of vapour left like broken clouds; when the flashing lights began to vibrate with a most prodigious swiftness both from N. E.

and

and N. W. pointing to the zenith, or a little more to the south. 'Twas observable that in the tracts over which these flashing lights passed the remaining parts of vapour, which now lay scattered every where like white broken clouds, pointed or seemed to have a tendency conformable to the same motion; whereas towards the due north where no flashes appeared these whitish clouds lay confused and irregular as before.

This continued about 20 or 25 minutes, when the wind began to rise a little at N. E. and the scene was quite at an end, dark clouds succeeding all over the north, and by 9 o'clock we had a severe storm of snow.

All the time of these appearances many broken parts of the extinguished vapours were carried like white clouds beyond the zenith, some 50 or 60 deg. and others even to the horizon it self at S. S. W.

During the whole continuance there seemed to be a small, easy breath of wind, scarce perceivable, at N. N. E. which the motion of the clouds above-mentioned also confirms, but as soon as it began to blow a little brisker the remaining parts of the vapour were all dissipated.

The weather both before and after this phenomenon was thus.

Jan. 30. Hard snow in the morning; frost all night.

Jan. 31. and Feb. 1, 2, 3, 4. pleasant sun-shine days, very calm, the snow still lying; at nights very hard frosts.

Feb. 5. very violent snow in the morning; some thaw in the afternoon; hard frost at night.

Feb. 6. hard frost in the morning; the wind exceeding cold and sharp, but not hard; the afternoon pleasant, sun-shine and calm; it froze all day out of the sun and all the evening; the ground still covered with snow.

Feb. 7. very hard frost in the morning; frost and storms of snow all day. Wind N. N. W.

Feb. 8, 9, 10, 11. pleasant calm days, but hard frost; very hard frost at night.

Feb. 12. hard frost; exceeding cold wind at S. E. At night these lights are said to have appeared again, as also on the 18th, to a very great degree, but I saw them not; the weather still frosty with little snow.

Feb. 22. at night hard snow.

Feb. 23, 27. a thaw and some rain; but little frost afterwards, only dry cold winds till the 27th, when the frost returned very sharp, with exceeding cold winds at N. E. and S. E. for a fortnight or more, without any snow, which did a great deal of hurt.

Another at
Castle-Dobbs
in Ireland in
Sept. 1725.
By Ar. Dobbs
Esq; n. 395.
p. 128. Aug.
&c. 1726.

8. The theatre of light forming an irregular variable curve was, as at most times formerly, from E. N. E. to W. N. W. the horizon and whole hemisphere serene, little or no wind, what there was seem'd northerly. The seeming dawn or stage of light generally continu'd in an irregular curve; the one point on the two first nights that I observed it began near the horizon about N. N. E. the other point was at W. N. W. the height of the arch not exceeding 20 degrees in which there seem'd to be a continual dawn. Under that field of light seem'd to be a dark cloud, which however was a clear sky not filled with that luminous vapour; because all the stars appeared distinctly and twinkling through it. Whenever that light rose to about 30 degrees, then flashes or coruscations followed alternately, and seem'd to be pillars or beams of light which followed one another, moving and changing so as to make a succession of light and darkness. When the lighted vapour rose higher to about 40 or 45 degrees then the appearance altered; and instead of beams or pillars of light, there were flashes like explosions, wherein faint colours of red, green and yellow appeared; and upon each explosion it would spread upwards towards the zenith in the appearance of thin enlightened clouds, and immediately disappear. On the 26th about 9 at night one of these irregular arches of light had got up to the zenith, the lower points being near E. N. E. and W. S. W. I observed it at least a quarter of an hour, and it had been there for some time before I saw it. I could distinctly perceive all the different appearances according to its altitude in the hemisphere; the lower part (about 12 or 14 degrees high) was a constant fixed light, equal to the light of the edge of a white cloud in the day-time when the sun shines on it. As it rose higher it became somewhat weaker, and the pillars or beams of light after each flash, seem'd to move. Somewhat higher again, at about 40 degrees, the flashes were like explosions of great guns, with the faint colours as before; but the coruscations or flashes from thence to the zenith expanded at every flash, like a broad, thin, white cloud, of which some faint view could be seen for some time after each explosion. And after all the explosions were over there remained a thin dusky vapour in and near the zenith and all along the arch from east to west, between 14 and 20 degrees broad, which undulated and moved like a stormy sea, the motion coming from the S. S. E. and so lessening 'till it appeared no brighter than the milky way, but more like a very thin cloud or mist through which I could perceive the stars. At the same time I saw another thin cloud having the same arched appearance, about the height of 40 degrees to the southward, which I suppose had been another which was over, and had moved thither from the northward before I went out. All this while there were lesser lights towards the north, but dis-

perfed

perfed here and there, without forming any large body. During the whole time the hemisphere was clear, except a few very small clouds near the horizon; and when any moved into the enlightened arch they broke the connexion, fo that the light was above them. It froze hard every night.

From thefe obfervations I fuppofe that the aurora borealis is a thin nitro-fulphureous vapour raifed in our atmofphere confiderably higher than the clouds, which is difcontinued in feveral places by the interfperfed air and kindled by preffure and motion; and perhaps the explofion of one may by its fhock and motion contribute to kindle the next, fo that they go off one after another 'till the whole vapour within their influence is difcharged, and then the light vanifhes and the thin fmoak appearing undulates according to the motion in that part of the atmofphere. And hence I think moft of the appearances may be folved. As to the continued light near the horizon, thefe explofions being at a great diftance from us and nearly in a line may feem as one continued light: when they approach nearer to us and by confequence appear higher in our hemisphere, we obferve the motion in each fafh, and ftill feeing them laterally, yet fomewhat breaking the continuity of the light; they (by the reflection of the vapour floating in the atmofphere, and being not reflected where the air betwixt them is free of thofe vapours) may appear as pillars: and as the fafh below and beyond them kindles and expands, fo they feem to move, and perhaps are really fhocked by the motion; but afterwards when they are nearer and raifed to the altitude of 40 degrees, we get fomewhat under them and fee the expansion of the explofion, which appearing fomewhat globular gives the faint colours obferved above, the light not being intense enough to make them vivid; and afterwards when they rife to or near the zenith, they are nigheft to us and then expand very wide at each fafh, like little clouds. The great objection of their appearing only in the northern hemisphere and feldom or never in the fouthern is in fome meafure answered by the appearance on the 26th; fince at leaft half of the arch was in the fouthern hemisphere; and perhaps the reason why the light is not feen near the horizon in the fouthern hemisphere may be this, that in clear ferene weather the wind being generally near the north, objects from thence are much more diftinctly viewed and at a greater diftance than from the fouth; for 'tis generally known that lands at a great diftance are moft diftinctly feen when the winds blow from them.

And perhaps a cold northerly freezing air may be needful to kindle the vapours, when a contrary motion higher in the atmofphere may carry the fulphureous vapour, which falling down from the nitrous vapour may be kindled, and form thofe undulations of the fmoak after the explofion, which feemed like a stormy fea moving

*A remarkable
one observed
Oct. 8. 1726.
at Petworth
in Suffex. By
Dr. Ben.
Langwith,
ibid. p. 132.*

from the S. S. E. The barometer was low for some days before and after.

9. The northern lights that appeared Octob. 8. 1726. were too remarkable to be passed over in silence. They began about sun-set; but I heard nothing of them 'till between 7 and 8. When I went out I observed a stream of light almost due west, which was about 7 or 8 degrees broad and extended it self upwards about 35 or 40 degrees. I had not a free prospect of the western horizon, and so cannot tell what its appearance was below. It was not perpendicular to the horizon, but inclined a few degrees towards the south. This stream was of a dusky red towards the north, but pale on the other side, and seemed to have a faint mixture of the prismatic colours in it.

At the same time there appeared a pale luminous arch whose middle was nearly N. W. by N. The altitude of its inner edge was about 18 or 20 degrees. This edge was very distinct and regular all above, but a little confused towards the horizon where it extended it self beyond the north point: how it terminated to the west I cannot say. From the upper side of this arch, which was waving and ill defined, there shot up continually such streams of light as have often been seen and described since the great meteor of March the 6th, 1713. The sky under this arch looked exceeding dark, but was in reality clear; for we could see the smallest stars in it.

Nearly N. E. there was another stream of pale-coloured light, which was about 7 or 8 degrees distant from the horizon and about as many in breadth: its height was various and ill defined. Towards the bottom of it was an irregular black cloud, which in some parts was near a degree in breadth, in others hardly half so much: this cloud was almost parallel to the horizon. The stream moved with a slow regular motion towards the east.

In the S. E. was another arch like that in the N. W. by N. but not quite so high or of so great an extent. Between this arch and the north-easterly stream the sky was of an odd pale coloured light, with a mixture of red in it.

From the south towards the west were gloomy irregular clouds, which now and then sent out flashes of light.

About 8 the north-easterly stream suddenly expanded it self every way: all its parts began to be in a violent commotion, and its brightness encreased to such a degree that I remember nothing like it in the former great meteor of this kind. All above it was of a bright flame-colour; but below it was edged with the prismatic colours, which were full as strong as I have ever seen them in the brightest rainbow: they were not indeed so distinct; for though I observed them as exactly as the strange variety of their motion would permit, I could only distinguish the red, the yellow, and a dusky bluish-green.

This

This surprizing sight did not last above a minute or two; but when the colours vanished here they began to appear in the north-westerly arch, which was now become a portion of a larger circle than before, and was not elevated so high above the horizon. The colours extended themselves from the north towards the west for about 15 or 20 degrees; and though they were not so bright as in the other place, yet they were more steady and so as easily observed. Their order was the same as before, the red lowermost, and so on: their duration much longer.

In the mean time the streaming lights began to appear in all parts of the heavens, and to form a corona and canopy which were in all respects like those of the great meteor of 1711. Instead therefore of giving a long detail of the particulars of these, I shall only take notice that the colours of the corona were neither so strong nor so lasting as those before described, and that the top of the canopy was sometimes over-spread with a deep fullen red.

The streams continued their direction upward towards a point of concourse for a long time after, and formed by fits imperfect circles of pale light about it. This point, however, was not fixed; for at first it seemed to be in or very near our zenith; but when I observed it some time after, it lay between the stars in Andromeda's right-hand and those at the end of her chain. The same observation was made by a curious gentleman of this place, who also informed me that there was another luminous arch which past quite through the pole-star: its continuance was short and I had not the good fortune to see it my self.

These appearances held in some degree 'till about 11, when the air began to grow misty and so put an end to any farther observations.

I cannot tell the exact point of the wind: it was so calm below that I could not be certain which way it stood; but some that were in a high open place assured me that it was north-westerly, as it was in the afternoon before and the morning after. The mercury was up at 30: the weather mild and temperate.

I shall conclude with the following observations.

First, It plainly appears from the position of the arches that they could not owe their figures to the sun: they seem to have been partly optical, and partly to have depended upon the different heights of the luminous vapours; but for want of sufficient data it will be no easy matter to determine how far each of these causes concurred.

Secondly, The prismatic colours, wherever they appeared, seem to have been caused by the sun.

Thirdly, None of the streams, as far as I could observe, proceeded directly from the horizon. They were nearest it towards the north, where there were some weak irregular lights in the confused parts of the arch before described.

K 2

Fourthly,

Aurora Borealis.

Fourthly, I find by some of my papers that during the meteor of 1712. the mercury stood at 30.2 ; so that the two meteors agree, as in many other particulars, so in these, that the air was calm, the wind north-westerly and the mercury high.

Fifthly, Luminous vapours in the air are much more common than they are generally taken to be ; for the nights are very often lighter when the sky is over-cast than in the brightest star-light, though pusculum be quite gone off and there be no moon.

...at Plymouth
by Dr.
J. Huxham.
ibid. p. 137.

10. Oct. 8. 1726. about half an hour past six, perceiving Jupiter shone very bright I was applying my telescope to observe him, when on a sudden several luminous streaks appeared about 10 degrees above the horizon in the N. E. and the hemisphere seemed much enlightened. Imagining this to be the beginning of a lumen boreale, I cast my eye carefully along the northern horizon from E. to W. and very nearly in the W. point I perceived a vast red fiery-coloured obelisk shoot it self up to the height of 30 or 40 degrees : it seemed perpendicular to the horizon, and its base appeared to insist on it ; its point almost touched the bright star in the northern crown, and a smaller column or two of the same colour and shape stood near it. In the mean time the light to the eastward encreased considerably and became more vivid ; as when the moon is behind a very bright cloud. It also formed it self into columns, which were projected to no great height, and would soon vanish, then soon return, and appeared not only in the N. E. but also more northerly.

In about a quarter of an hour from my first observation, as from an arch or black basis (I know not better how to express it) which extended all over the northern horizon, and seemed to intersect it nearly in the W. and E. N. E. points, arose abundance of pyramidal columns of light on all parts of it ; now here, now there, of unequal bigness, height and lustre ; now suddenly gleaming forth, then as suddenly disappearing ; but those columns that were to the eastward of the N. were more bright and lucid than those to the westward, which were of a more fiery, rutilant colour. The great column in the west still remained in the same position, height and shape ; as I observed by applying my eye to a wall very near E. and W.

Between the arch and the horizon appeared as it had been a black dusky fog, from whence the streams of light seemed every where darted forth : yet however black this appeared we could discern the stars very clearly through it. This arch at its first appearance seemed not to be above 15 or 20 degrees (at its highest part) above the horizon ; but it continually grew higher, and from all parts of it cones of light were every moment shot up, which all seemed to tend to a point near the zenith (as the vertical circles or arches on a globe tend to its pole) though as yet none reached it by several degrees.

After

After 7 a clock the columns to the westward appeared bright and vivid as those in the E. except those very near the W. though the limb of the arch would seem sometimes very regular and well defined; yet at other times it would seem to sink, now in the middle, then at one part, then at another; and sometimes it would rise with the same irregularity: but it was certain that during the whole time of the phænomenon, no light or flashes of light did appear in the black area included between the arch and the horizon; even when it was at its greatest height, which was about ten or twelve minutes before eight, when I judged it to be at least 40 degrees above the horizon. Then from all parts of the arch, but first from the northern or highest parts of it, were rays or lucid columns of a surprizing brightness and lustre darted with incredible velocity towards the vertex, where the cusps of the converging columns seemed nearly to center; and suddenly from every quarter of the heaven, bright, shining streams of light were shot towards the zenith; which meeting about 6 or 8 degrees to the southward of it formed a small circle of two or three degrees diameter, whose border was much more lucid than near its centre. This circle seemed formed between *cauda cygni* and the lizard then nearly upon the meridian.

This beautiful spectrum might be likened to the star worn by the most noble order of the garter, but the pyramidal radii were here reversed; and from the southward the rays or *striæ* were not near so long as those from the N. especially those from the due S. not reaching above 10 or 15 degrees from the centre or circle; whereas those from the eastern and western quarters were very long, and reached almost down to the horizon; especially in the E. and W. points. The radii were in a continual and exceedingly swift undulation, and appeared of several very bright colours, as white, red, green, yellow, for several seconds; but the most permanent and predominant colours were a fiery red, with an eye of crimson, and a bright pearl colour. The red rays came mostly from the westward, and that colour continued 'till the intire dissipation of this radiant canopy; the others dying away and leaving as it had been a thin smoak. The vibrations of these radiant columns were as swift as flashes of lightning and incessant.

This surprizing sight remained over us in its full glory 3 or 4 minutes, during which time the rays were darted towards the centre with prodigious swiftness, and did not seem to be shot from it. Sometimes they undulated like the vapours arising from a lime-kiln, or from the earth in very hot weather, and all the upper part of the hemisphere seemed to be in a kind of convulsion.

In a short time this agreeable scene vanished and was broken into small flitting bright clouds, which still retained an undulating motion; and coruscations would every now and then break forth from them.

At

Aurora Borealis.

At this time also I observed several star-like meteors fall, as is frequently observed in a bright serene night.

Though our glorious cupola disappeared a very few minutes after 8, yet very vivid coruscations were shot continually from the N. E. and N. W. parts of the heaven, which dashing against one another near the zenith formed by their collision momentary arches of a circle, nearly in the same place and of the same diameter with that above mentioned. None now proceeded from the south, and very rarely from the true north. The coruscations were always more red and fiery from the westward than from the east, which were always more bright and luminous.

We were lost in the contemplation of the beautiful phenomenon over our head and did not observe the formation of a lucid arch projected over all the northern horizon, which seemed like the arch of a rainbow of one vivid, bright, yellowish colour, and all under was, as it were, a very dark cloud; though by viewing it with a telescope we could discern the minutest stars: so that the darkness only proceeded from the greatness of the light just above it. From this, as from the former, arose very lucid, bright columns on all parts of it. No coruscations appeared under it. Its greatest height might be 20 or 30 degrees. Some of the columns seemed to radiate even to the zenith from this arch.

About 9 this lucid arch vanished insensibly, with most of the luminous radii or columns; but, as it were, a very bright crepusculum still remained all along the northern horizon, and several very bright coruscations would seem to be shot out of the pure sky: this was more especially observed in the N. E. About 11 I observed several coruscations still breaking forth, and here and there a luminous column; and several little bright clouds seemed irregularly scattered up and down the hemisphere, which still retained their darting and quivering motion. The northern crepusculum remained as bright as ever, and so continued 'till past 2 in the morning.

There were but very few and those very small clouds to be observed during the whole time of this phenomenon, and the air was clear; yet all around and between the lucid columns, whenever or in what part soever they appeared, the air would seem very thick and hazy; though immediately upon the disappearing of those gleaming lights the sky would in the same place appear very clear and serene. Nay, even through some of the very columns we could plainly discern the stars. Some gentlemen thought they saw the bright stars of the swan through the corona it self.

As to the weather preceding and following this phenomenon; the morning was fair, though the air was thick and we had a great dew: the mercury was at 30 inches. Hawksby's thermometer at 50; little or no wind. The day was pleasant and warm, and the air grew much thinner. The evening was serene; a very soft breeze from N.

and

and by W. About 5 the next morning, there were several clouds formed, and the air was very thick and hazy, at 7 it was all cloudy and a few drops fell.

Though I had before seen several faint appearances of the aurora borealis; yet this, for beauty, lustre and duration, vastly exceeded any thing of that nature I had ever seen. Indeed I saw not that of March 6th, 171 $\frac{1}{2}$ being not then in England.

11. Oct. 8. 1726. coming from the country near 7 in the evening I observed a great light in the east and west, which soon extended it self over our heads, the north and south appearing dark at the same time. No cloud was seen all that day. A great dew fell on a sudden, with which the streets were wet as by a small rain. Half an hour after 7 many streams appeared in the north, which grew very bright, and darted frequently up to the zenith. A line drawn through the bases of them made an arch of a circle extending from the N. E. to the W. or S. W. But the streams seemed to proceed from a clear sky, being distinct from one another at the bases, and not united by a luminous arch or cloud as in the more usual auroras. The streams at the two extremities of the arch were brighter, wider and longer when they did not shoot than those on the top of it. There was at the same time a luminous arch extending it self from the two extremities of the above-mentioned aurora through the south at a considerable altitude. About eight o'clock the streams began to have an horizontal motion, propagating themselves on both sides towards the south; and in a minute or two the whole heaven was surrounded with them. Immediately they all extended themselves up to a point near the zenith (I think a little towards the east) where their points were blended together in a confused manner. At the same time every stream which before was white appeared striped with all the colours of the rainbow; but the most prevailing colour was a deep red. It is impossible to express the beauty of this glorious umbrella, which covered the whole hemisphere with its variegated rays, the colours whereof succeeded one another in a regular order. In the centre of these rays was a confused rolling, agitation or ebullition of a luminous cloud, appearing like smoak. In about ten minutes (as I judged) the colours disappeared, and the streams began to retire from the zenith; presently after which they would frequently dart and shoot with great celerity up to the same point. This darting and flashing, together with a tremulous motion from all sides of the horizon, I observed 'till 12. And I am informed that it continued 'till four in the morning. The most considerable rays came from the east and west. Next morning we had a fog.

... at Exeter.
By Dr. W.
Hallet.
ibid. p. 143.

Fig. 15.

The best account which I can give of this phenomenon is this: I imagine a thin cloud composed of a sulphureous exhalation hanging over us in the air, at a considerable height and parallel to the horizon; the

the length of it being very great from east to west nearly; the breadth of it, at first, not so great, but that we might see the stars from under it to the north and south. The north side of it, I suppose, first took fire, and shot its streams or flames perpendicularly upwards, which being undisturbed by winds must appear streight and pointed at the top. The bases must make an arch by the rules of perspective: for, I think, an horizontal right line of a vast length and at a great distance from us, such as I take the northern edge of this luminous cloud to have been, seen at a considerable height in the air, must appear bent down into an arch. On a sudden the fire propagated it self to all parts of this vapour. The whole heaven must then appear covered with the same streams, which though really parallel to one another must appear bent into a cupola. The shooting and darting of these flames, and their concurrence, together with a smoak proceeding from them, must give that confused cloud which was observed in the centre of this canopy. The regular disposition of the colours in every stream others perhaps may account for. I think the red appeared at the right hand in all of them. I have somewhere met with an observation of an aurora, in which the streams were coloured only where they met, or crossed one another. Whether the light of one stream passing through another may not be separated into colours by refraction I will not determine. If the altitude of the top of the arch in the north had been taken here, and at the same time at another place upon the same meridian whose distance is known, from thence I imagine the height of the cloud, as I call it, might have been calculated.

..... near
London. By
Joh. Hadley,
Esq; *ibid.*
p. 146.

12. The first sight I had of this appearance was about half an hour after seven of the clock; at which time it had nothing remarkable to distinguish it from those others which had been observed almost every evening for some time, except a dusky redness arising from the western extremity of the luminous arch; and that at the same time there was seen another such hazy arch low to the southward, fainter, but more steady than that to the north. I judged the highest point of it to be somewhat more elevated than the sun at noon about the winter solstice.

In a short time after, the northern arch was risen considerably higher from the horizon, and continued to advance towards the zenith 'till 8; when in one part it passed among the uppermost stars of Cassiopeia, and in another close below the bright star in the harp. The heavens underneath looked clear and of a dark blue, having no resemblance either of dawn or dusky cloud, and the pyramids of light seemed to spring immediately out of the pure sky. The arch it self was very irregular, being full of notches, some greater, some less. The dusky red on the west was changed to a light crimson, and was answered by the like colour on the east. The rays issuing from both extremities were thick and bright, appearing as if there were several one behind another.

another. They were also generally longer than the rest and pointed considerably to the south of the zenith. After 8 the northern arch retired again downwards 'till it came among the stars of the great bear; when the whole scene was changed on a sudden, and rays were darted up from all sides, forming that crown-like or star-like figure which has been sufficiently described.

The intermediate area left between the innermost extremities of the rays coming from different quarters, which very rarely, if ever, joined) was of an irregular figure, commonly inclining to an oval, whose longest diameter lay east and west. Sometimes it appeared as clear sky, at other times was filled with a thin white cloud, and that cloud was often divided into two parts by an uneven crooked line running likewise east and west.

The rays which immediately surrounded this void space were of no great length and very unstable: yet two or three times, when they continued steady enough to afford an opportunity of considering them attentively, their outermost extremities were sensibly carried southwards, the center it self remaining, to appearance, fixed.

The southern quarter was filled with continual flashings of light. These followed one another very quick and were propagated upwards from the aforementioned arch with great swiftness, each of them leaving in some parts of the space it passed through a faint and very transient whiteness, which presently vanished and was quickly renewed, usually in the very same track, by the next succeeding flash. Yet none of those tracks were in any degree direct and uniform, but all very irregular and broken.

The central figure sometimes disappeared for a while and then returned again. Whether it always retained the same situation with respect to our horizon, I cannot depend on the exactness of my observations enough to determine. They were as follow.

About half an hour past eight the center, as well as I could judge by my eye, was very near a star of the fifth magnitude, placed by Hevelius at the end of the lizard's tail, whose present right ascension is about 331° , and decl. 36° and an half N. At nine it was at the northern point of an isosceles triangle, whose base was a line joining the star in Pegasus shoulder, called Scheat, and the brightest of those in his knee; the perpendicular from the center being in proportion to the base about as 3 to 2. At 9h. 15' the triangle made between that and the two forementioned stars was become right-angled at Scheat, the distance being not much altered. At ten it was directly between the zenith and Andromeda's head, at a distance from this star not sensibly different from what it had kept from the northernmost of the two forementioned.

According to the first of these observations the central point must have been very near the meridian, and about 15° south of the zenith

of the place where I was ; which is a few minutes directly north from London. The three last agree pretty well with one another, to carry it between two and three degrees further southward, and to give it a perpendicular distance of 3 or 4 degrees of a great circle from the meridian eastward.

In the remarkable appearance of this kind which happened the 6th of March 1713, I observed the like center at near half an hour after 7 o'clock to be something nearer the zenith than the bright star in the northern head of the twins, and to be more easterly by about half the distance between that and the star in Pollux's head. By comparing this observation with the situation of the star at that time, the center appears to have been about 16 or 17 degrees from the zenith, and about two or three distant from the meridian circle towards the east.

... at Geneva.
By Mr. J. L.
Calandrini,
ibid. p. 150.

13. Die saturni $1\frac{1}{2}$ mensis Octobris, horâ sextâ & dimidiâ vespertinâ, aurora borealis fulgere cœpit, phænomenon vobis quidem satis familiare, nobis verò ex seniorum sententiâ plane novum, sed tam illustre, & circumstantiis à vulgaribus in transactionibus sæpe descriptis tam diverfum ut de eo audiisse fortasse non pigebit.

Primò quidem, quâ horâ dixi, arcus lucidus visus est, cujus medium stabat in horizontis septentrione, extremitates ad Arcturum in occasu & ad Pleiades in ortu, 40° altus; lucidus satis, ut solem è septentrione jamjam ortum ire diceret; sed hic nihil est novi.

Post horam septimam quasi violenti incendii flammæ vel continua fulgura totum albicantis arcus locum occupaverunt. Serpebant ex horizonte ad cœli fornicem haud absumiles veri furni flammis, extremitates arcus rubicundo atrove fulgore vulgum terrebant, ipsæ flammæ in atrum fumum desinere videbantur, ita ut diem Domini instare mulierculæ non dubitarent. Cœleste hoc incendium plusquam horam duravit; scenâque mutatâ, ex horizonte exilire columnas quæ ad zenith pertingerent visum est: ex eâdem supradictâ basi, coronâ in extremitate phænomeni tum occidentè & cornu tauri inferiore ab alterâ parte surgente, columnæ plus minusve latæ, 60 aut 70° altæ, tria vel quatuor minuta durantes, paulatim evanescentes, vel prius in igneum colorem versæ; post aliquod tempus cessarunt columnæ: tum aurora borealis ut primum fulsit, cui ante decimam successerunt flammæ vehementiores quam prius, quibus cessantibus columnæ circa undecimam visæ sunt, magis diutinæ & 120° plerumque altæ: rursus aurora, mox flammæ, postea columnæ, atque ita ad tertiam usque, quâ videbantur adhuc phænomeni reliquiæ.

Ultra luculam, quæ semper septentrionalem cœli partem illustrabat, majoris Ursæ stellæ parum fulgebant. E Vesontio, quod 90 milliariibus hinc distat, eodem modo visum fuisse phænomenon accepimus.

Arsit interea meteoron, vulgo stella cadens dictum, quod ultra phænomenon arsisse visum est.

Ex reflexione solaris luminis à partibus atmosphære borealibus congelatis auras boreales formari dictum est: sed flammæ adeò notabiles quo pacto explicentur non video. Si ab exhalationum incendiis ortum hoc phænomenon censeatur; aurora borealis phænomeni comes, columnæ, duratio phænomeni, & ipsius in eodem loco statio negotium facessent.

14. Oct. 8. 10 { Barom. alt. { Therm. { Wind { Weather fair
morn. 29. 90. { 54. { W. 1. { and clear.

..... at South-
wick in North-
amptonshire.
By G. Lynn,
Esq; n. 398.
p. 253. Apr.
&c. 1727.

This evening appeared an aurora borealis, I think full as remarkable as that in March 1716, though varying in form: it began about six at night to be light in the north with streaks proceeding from it, and spread gradually both towards the east and west, the south being still very clear; but before seven it left all the northern parts (except towards the zenith) and covered all the southern. Soon after which there appeared a white arch proceeding from east to west and passing near the zenith, but more southerly, which seemed fixed for a time; but about ten minutes past seven it dispersed, and was immediately succeeded by a kind of glory of an oval form, the longer axis from east to west, something south of the zenith, with rays shooting up from all parts and interchanging swiftly, for about 15 or 20 degrees from it; the rest of the heavens (except the north, which still continued very clear) affording various phænomena. In the east there was a quick succession of columns of the iris colours, inclinable to white, the west to purple, and about the south-west, for a good space, appeared almost a blood-red coruscation, which continued 5 or 6 minutes.

These appearances in a quarter of an hour became less remarkable; though the aurora continued most of the night, and afforded a light generally equal to the moon in its quadratures. Looking with my telescope at Jupiter I found both his satellites and belts appear as plain through the aurora as if the sky had been perfectly clear.

15. M. Gaudin in a letter dated from the observatory at Paris Oct. 20. N. S. 1726. writes, that he saw it first at half an hour past seven in the evening, forming at that time a luminous arch, with another somewhat darker under it, which extended it self almost from sun-set to moon-rise, and was raised above the horizon about twenty-five degrees; from whence shot out from time to time luminous streams about ten degrees above it. At half an hour past eight the number of these streams vastly encreased, covering all the heaven, excepting the height of twenty degrees opposite to it: but towards the zenith there remained a circular space which was never covered by them, though there wanted not a constant succession. These appearances continued very strong 'till half an hour after ten, when they began to decline, and disappeared totally about two in the morning.

Extracts of
several letters
relating to the
same appear-
ance, Com-
municated by
Sir Thomas
Dereham.
n. 402. p. 453.
Apr. &c.
1728.

M. Maraldi, in a letter dated Oct. 20. 1726. N. S. at Thiers two leagues to the south of Paris, says it began there about half an hour past six with a constant uniform light in the north; soon after which appeared three or four luminous arches one over another, from whence issued a great number of rays shooting up a considerable height above the horizon. At eight o'clock these rays darted quite up to the zenith; half an hour after which they very much encreased, spreading with strong undulations all over the sky, and all terminating in the zenith formed a sort of cupola there. The conclusion he did not observe.

Sign. Fran. Quarantotti writes from Treggiaia Oct. 20. 1726. N. S. that he first observed it a little before eight in the evening, when it extended it self along the north horizon about eighty degrees, and reached above it about eight. After some time the luminous emissions began to rise perpendicularly and continued by intervals so to do from nine 'till eleven. About ten it enlarged it self fifteen degrees farther east, and stretched under the last star in Ursa major. At eleven it vanished.

An anonymous account in latin from Florence informs us that it was first seen there at half an hour past six in the evening, with a clear expanded light occupying all the space betwixt the N. E. and N. W. At seven it divided it self into several spherical triangles near the horizon, which half an hour afterwards united into one large one, whose base was near the horizon, and extended twenty degrees to the west from the north-pole, and whose vertex reached up to Ursa minor. This continued about half an hour and then disappeared; but at ten o'clock it returned much more conspicuously, forming about the pole a large column which was raised thirty degrees above the horizon. From this time it issued out lucid undulations 'till midnight, when it entirely dispersed. He afterwards takes notice that the same was seen at Milan and Bologna; the accounts from whence agree that none of the streams reached beyond the zenith.

Sign. Manfredi writes from Bologna Jan. 3. 1727. that he did not observe this phaenomenon himself, but was informed that it was seen every where in the Campagna di Roma, as far as Pesaro and Fano.

Dr. Eric. Burman in the Aët. Literar. Suec. Trimest. prim. 1727. takes notice, that although this meteor was seen in Germany, Poland, Switzerland, France, and England, yet at Upsal they could observe nothing but the whole sky beset thick with clouds, of a colour like that of the moon in a total eclipse, and variously agitated as by a wind, but this chiefly towards the south; which continued 'till nine o'clock at night, a little after which it grew quite cloudy.

16. There are two sorts of streamings which I have taken notice of, one by way of explosion from the horizon, the other by opening and shutting, without such shootings up and swift dartings as those which appeared in the lumen boreale March 6. 1718.

Observations
on it by Mr.
W. Derham.
n. 358. p. 245
Apr. &c.
1727.

Of

Of the latter sort chiefly was this last of Oct. 8. 1726. in which although the streams were as large and remarkable as in the former, yet they exhibited themselves principally by the vaporous matter opening and shutting, as if a curtain had been drawn and withdrawn before them.

The first view I had of this phænomenon was precisely at eight o'clock in the evening: at which time all I saw was a long narrow fascia, like a white ragged cloud, extended cross the heavens from W. b. S. to E. b. N. which in a few minutes began to emit some streams, and then disappeared. This was succeeded by much streaming in the northerly parts; and in a quarter of an hour it began to reach other points also; and soon after it streamed all round in the S. E. and W. parts as much, or nearly as much as in the north. Which was a thing I never had seen before.

These streams or cones were for the most part pointed, so as to make the appearance of flaming spires or pyramids; some were truncated and reached but half way: some also were longer, and some shorter; some had their points reaching up to the zenith, or near it, where they formed a sort of canopy or thin cloud, sometimes red, sometimes brownish, sometimes blazing as if fired, and sometimes emitting streams all round it, which at that time gave it the appearance of such a star as our knights of the garter wear on their breasts. Fig. 16.

This canopy was manifestly formed by the matter carried up by the streaming on all parts of the horizon: which matter sometimes seemed to ascend with force, as if impelled by the impetus of some explosion below, as in Mar. 1718. This forcible ascent of the streaming matter gave a motion to the canopy, sometimes a gyration like that of a whirlwind; which was manifestly caused by the streams striking the outside parts of the canopy, as in the figure: but when the streaming matter hit the canopy in the middle, all was then in confusion.

These two particulars, the streaming all round the horizon, and the canopy in and near the zenith, were taken notice of in all parts of England that I have met with any accounts from, and in diverse parts beyond sea.

Mr. Wasse in his account of its appearance at Aynho in Northamptonshire writes, that at 7 h. 20⁴ p. m. he saw an arch somewhat curved like a rainbow at first, about half the breadth of the rainbow, and yellow; which in about ten minutes began to twist and make an angle at the zenith: that one end of it was pretty much to the east, and not directly to the north, the western end deflecting as much to the south: that it remained after the twist at the zenith without any great motion not a quarter of an hour. After which the rods arose on all sides from the horizon to the zenith, the upper points seeming to move through a sort of vortex quite out of our atmosphere: which rods, he thinks, rose perpendicularly from the horizon, but seemed to converge towards the zenith, according to the rules of perspective, by
I their

their angle then being less than their basis at the horizon: that a redness was perceived, which, he thinks, was strongest towards the west, but did not appear 'till the arch brake into several pieces and overspread the heavens with a thin faintish fire, through which they saw Jupiter very clearly.

This account of Mr. Wasse's may shew how the phænomenon was in England; most of the accounts I have met with concurring in the main with his. But in the more southerly parts of Europe I take it to have been somewhat different. The news-papers tells us from Scaffhausen, " That on Oct. $\frac{12}{8}$. there was a great alarm in many parts of " Switzerland, on account of a great light seen in the air from seven " o'clock till midnight; which was supposed to be the reflection " of some great conflagration. At Bern every body thought there " was a fire in some part or other of the city or neighbourhood. At " Neufchatel the alarm-bells were rung, and the governour was several hours on horseback to give orders as in cases of distress. " All which they heard afterwards was only an aurora borealis." And from Florence Sir Tho. Dereham sent me this account; " As to " the lumen boreale, which appeared in these parts Oct. 8th last, I " saw it my self in the following manner: an hour and half after " sun-set when I was passing through a piazza in this town I discovered the phænomenon which seemed one mile long and three quarters of a mile broad, of an almost perfect oval figure, hanging " north and north-east to us: the edges of it were of a pale light " colour, like the first dawn of the morning; and towards the center it encreased its fiery colour; so that in some places it looked " as the fire of a furnace; but in the very center, and many adjacent parts, it was like a red-hot iron growing cold, that seems bloody. " For a good while I could perceive no motion in it; but after a quarter of an hour, I discovered a general slow motion backwards and " forwards, like that of the circulation of the blood in the tails " of fishes seen by the help of the microscope, but no manner of " darting; insomuch that in another quarter of an hour it vanished " imperceptibly, just as a rainbow, and the air grew dark again, " which was so luminous before that one might read a manuscript by " it. 'Tis very remarkable that at Fesole, a town within a short " mile of this, the phænomenon seemed to be between them and us, " and they thought our town was burning: whereby it appears not " to have been very deep nor very high; Friesole standing upon a hill " half a mile high and to the N. N. E. of this town."

To these observations of my own and my correspondents I shall add two or three things more, before I enquire into the cause of the phænomena.

It was taken notice of in most places that in some part of the greatest streaming the vapours between the spires were of a blood-red colour.

I observed that about half an hour after eight the vapours towards the S. W. were very dense, and for some time red. And not long after the like redness arose in the N. E. and the other gradually went off. Both which gave those parts of the atmosphere the appearance of blazing lances and bloody-coloured pillars.

Another thing I took notice of was, a strange commotion and working among the streams, as if some large cloud or other body was moving behind them and disturbed them.

In the N. and S. parts the streams were perpendicular to the horizon; but in the intermediate points they seemed to decline more or less one way or other; or rather to incline towards the meridian.

As for the weather, the preceding day was cloudy with an hoar-frost in the morning; but it cleared up and grew warmer afterwards; yet towards the horizon continued very vaporous. Before sun-rise the morning after the streaming the air was full of vapours, with diverse thin vaporous clouds, some of a lucid brown, some reddish: I took them to be remains of the streaming which, I was informed, continued all night.

As for the cause of these phenomena, I took them to proceed from the same matter or vapours which produce earthquakes: first, because some of these phenomena have been followed by earthquakes; Stow relates in his annals, "That on Nov. 14. 1574 were seen in the air strange impressions of fire and smoak to proceed forth of a black cloud in the north towards the south." That "the next night following the heavens from all parts did seem to burn marvellous ragingly, and over our heads the flames from the horizon round about rising did meet, and there double and roll one in another, as if it had been in a clear furnace." After which, "followed on Feb. 26th great earthquakes in the cities of York, Worcester, Gloucester, Bristol, Hereford, and in the countries about, which caused the people to run out of their houses for fear they should have fallen on their heads. In Tewksbury, Breedon, &c. the dishes fell from the cupboards, and the books in mens studies from the shelves, &c."

So this in Oct. last was preceded by that fatal earthquake at Palermo in Sicily, and succeeded by one in England Oct. 25 following. This, I hear, was perceived in London, and was so considerable at Dorchester, Weymouth, Portland, Portsmouth, Purbeck, and diverse other places in Dorsetshire, that it caused the doors to fly open, shook down pewter off the shelves, and was felt in some ships that lay in the harbours.

Another reason is, that I am assured by an ingenious gentleman of my acquaintance, that as he was viewing this appearance on the top of his house at little Chelsea, he plainly perceived a sulphureous smell in the air; and that another person did the same on the top of a house near him.

Another

Another thing which concurs with what hath been said is, that I am assured from several persons that an hissing, and in some places a crackling noise was heard in the time of the streaming, like what is reported to be often heard in earthquakes.

I shall conclude with these two remarks;

1. That it may help us to resolve several difficulties relating to these northern lights to observe, that what was streaming or darting in our northern parts was only a remarkable light or blaze in Italy and the southern parts.

2. That if those phænomena have the same origin that earthquakes have, they are doubtless of great use to the peace and safety of the earth, by venting some of that pernicious vapour and ferment which is the cause of those terrible convulsions.

I forgot when I described the canopy or corona to observe that it did not rest in one place, but changed its position, sometimes higher near the zenith, and then towards the E. and S. E. 10 or 15 degrees, and then back again nearer the zenith, according as the darting matter directed it: but I do not remember that this canopy was at any time directed towards the western points.

In most of the northern lights that I have seen, there generally was a dark bank of vapours circular on the top; but whether this of Oct. 8. had any such arch I could not see at Upminster, where I was surrounded with trees.

*An account
of the lumen
boreale as seen
at several
times. By
Dr. Ben.
Langwith.
n. 399. p. 301.
July, &c.
1727.*

17. Jan. 4. 1724 a luminous arch extended it self from N. E. to W. The streams all moved westward. Wind N. W. Merc. 29½.

Jan. 5. we had something of the same nature, but hardly enough for observation; and yet this very night the appearances were more remarkable in some parts of the kingdom than those of Oct. 8.

March 2. between 7 and 8, there was an arch upon a black basis as before, extending it self from N. E. to W. Its height variable, pyramidal streams of greenish light moving westward. About a quarter past 8 there shot up from the west a stream of pale flame-colour about 6 or 7 degrees broad: it passed over the pleiades, and crossing the meridian about 19 degrees to the N. of our zenith descended as low as the tail of Urfa major which it left a little to the S. It continued thus for some minutes and then gradually vanished. Wind N. Merc. about 30.

March 3d. the appearances this night were so extraordinary, that they would require a long description: but I shall chiefly take notice of such particulars as differed from those of Oct. 8.

1. Instead of one luminous arch in the N. here were two and sometimes three one above another. They were distinct enough from each other in their upper parts, but blended together towards the horizon, which they generally cut about N. E. and N. W. but sometimes

times varied considerably from these points. The same observation may be applied to the heights, for they were also variable; and in particular the inner edge of the lowermost arch was at some times about 6 degrees above the horizon, at others considerably more or less. I suppose this extraordinary appearance was owing to several distinct collections of luminous vapours, which were either at different heights from the earth, or different distances from the eye.

2. Several of the more permanent streams were bent, at times, into irregular arches of different curvatures and positions. Some of them held pretty near the same shape 'till they vanished, others went off most commonly in tangents to some part of the former curves.

3. The flashing streams from the E. sometimes met with those from the W. and so formed continued arches of a pale colour, which quickly broke and vanished. No colouring followed upon the mixture of these streams.

4. The streams of this kind moved mostly S. but not to any certain point; for they were inclined to the horizon at all degrees between 5, or less, and 90. There was sometimes such a strange irregularity in their motions as can hardly be described; for the places from whence the flashings were directed seemed to vary every moment. As to the more steady pyramidal streams, they generally moved W. and though some of them, at times, seemed to stand still or even move backward, yet I am apt to believe this irregularity was only apparent.

5. A little after the beginning of this meteor there was a faint ruddiness in the sky towards N. E. and N. W; but towards twelve o'clock, when it was in its greatest perfection, I saw none of the prismatic colours, though the air was then full as light as I have ever known it upon these occasions. This helps to confirm me in the opinion that the prismatic colours in these meteors are owing to the sun.

These appearances began early in the evening, and held, as I am informed, for a good part of the night. Wind N. W. Merc. above 30.

I am told that these meteors are much more common in the N. of England than here, and that they go by the name of streamers, merry dancers or pretty dancers. They also pretend to foretel the weather by them, and say that when the streamers are green they betoken wet stormy weather; but when they are yellow it will be clear and dry.

I don't know whether it is worth while to acquaint you, that Aristotle has given an imperfect account of some of these meteors.

18. Jan. 5. 1722, about 7 o'clock at night I was told that the meteor called by our sailors merry dancers was visible and very bright. Having seen several before, but without any opportunity of being particular in my observation, I went out into the open air, clear of houses, that I might have a better view all round the horizon; from whose

An Aurora Borealis at Liverpool. Jan. 5th. 1722. By

Aurora Borealis.

northern part arose several streams of light, as if from behind a black cloud. They were very many, and I believe, there was no possibility of numbering them, their motion was so quick shooting upwards to the zenith with a motion not to be followed by the eye. They had also another motion which seemed to be side-ways, their higher ends terminating sometimes in a sharp point, sometimes in two or three points; they appeared from the N. W. to N. E. but were brightest in the N. Their colour was pale like that of Jupiter through a telescope, but not near so bright. Most of them reached the zenith, where mixing with one another they whisked round and formed an appearance like the curling flame of a glass-house-fire; they had a very irregular motion, sometimes turning inwards, sometimes outwards, like the pendulum-spring of a watch. This circular light was the brightest, and seemed to occupy near ten degrees of the highest part of the hemisphere: several strokes of light seemed to dart from it to the S. but died before they got to any considerable distance. In the W. I observed two small long clouds that interposed betwixt me and the light streams, which I saw over the clouds and betwixt them; so that I am convinced this light, whatever it be, is far above them. I have drawn a scheme of the whole horizon as it appeared to me. The bright star in the figure is Jupiter, who was then in 17° of Aries, about S. W. and I guess about 20° high. Some of the brightest stars in Taurus, Orion, and Aries appeared S. and S. E. but those I have placed only by guess. In this state I left it: but was told by one that saw it after 10, that the whirling light in the zenith appeared of several colours, as blue, green, yellow, and reddish.

Fig. 17.

Uncommon
appearances
in one seen
Oct. 13. 1728.
By Mr. W.
Derham.
n. 410. p. 137.
July, &c.
1729.

19. Oct. 13. 1728, about 8 in the evening my family and others at Windsor saw a considerable streaming in the N. with such bright lances and columns as usual. But at Redbridge in Hants none such appeared, only in the N. I observed a great thick black bank of vapours, the top reaching about 20° above the horizon, without any such convexity or curvature as is usual in most of the streamings I have seen; but instead of that, the upper part was indented in many places with long black pyramids, somewhat resembling the streams of the lumen boreale, the edges of which were gilded with lucid rays of the streaming colour: I observed a great commotion throughout all the vaporous bank, as if something was rolling or tumbling behind it. The end of all these appearances I expected would have been streaming: but in less than an hour the clouds, which had been pretty still, began to move to the S. W. and at last obscured the whole hemisphere, which before was all clear enough, except towards the N. to shew the stars, although bespread with vapours like a thin fog a little inclining to red.

20. The

20. The aurora it self had nothing extraordinary; it was a quiet one without any sensible motion, except perhaps an alternative encrease and diminution of apparent altitude. Whether it was for this reason, or because the light had its edge imperceptibly confounded with the colour of the sky, different people judged of that altitude differently. Some pretend to have seen it to the very zenith: I was not so happy, and could not see it higher than the girdle (β) of Cepheus, which was about 30 deg. high. The greatest part fixed it to the polar star which is about 46 deg. Its base reached from the head of Andromeda and further, to the shoulder (γ) of Bootes and further, and so it stood upon an arch of 140 or 150 deg. of the horizon. This measure was taken half an hour after eight. Its middle declined from N. to W. about 15 deg. The light was still and clear enough to read a small character. The base seemed obscure to some people.

But what was chiefly to be considered was a great meridional zone pretty like a rainbow in its figure, but broader. It was terminated by two parallel arches. The superior insisted with one side upon the true point of E. and with the other upon the point of S. W. or W. S. W. whence you see its middle declined about 15 deg. from S. to E. and was diametrically opposed to the middle of the aurora borealis. Its altitude varied a little, but never reached higher than the head of Orion which was 54 deg. high, and never was seen lower than a little under Procyon which is an altitude of 45 or 46 deg. The inferior arch was exactly parallel to the superior, and the breadth of the zone varied from 14 or 15 deg. to 18 or 20 deg.

The colour of this zone was red, scarlet enclined to purple, pretty lively and changeable by intervals. It was less vivid near to the horizon, and also to the meridian where it seemed now and then interrupted. Some standers by imagined two great arches rising, one from the E. the other from the S. E. and meeting together near the meridian, but immediately afterwards parting one with another and drawing back, which they repeated very often.

Under this zone then was to be seen, but not constantly, one or two arches lucid and interrupted, which comprehended with the horizon a dark segment very like a mist.

The phenomenon lasted 'till four o'clock in the morning. The weather was calm, serene and cold, the barometer very high; no cloud in the heaven.

It was remarkable, and I think extraordinary, that this aurora considerably darkened the light of those stars which were seen through it; and that was much more true of the red meridional zone which died with its reddish colour the stars that appeared behind it. When that zone was the highest it covered Jupiter; and some gentlemen, who at that time had not yet remarked the aurora, looking at Jupiter through a telescope affirm they could hardly see it, but that it seemed

.... in one at
Genev. Feb. 1st,
1723^o. By
Mr. G. Cra-
mer. n. 413.
p. 279. Mar.
&c. 1730.

as intercepted by some dark cloud; and indeed it looked at that time as if it had been seen through a red glass.

This observation confirms what is moreover very probable, that this zone was produced by the light of the opposite aurora, either by reflexion or refraction. But the manner of its production seems difficult to account for. We may suppose icy particles swimming in the air, and of such figures as to exhibit a great zone by the reflexion and refraction of the light of the aurora, almost in the same manner as the drops of rain produce the appearance of the rainbow. But this is mere conjecture.

The aurora and zone seemed a great deal nearer one another in the horizon than in the top. If we could suppose this difference to be entirely optical, and these two circles really parallels, that would be enough to determine the distance of the phenomenon from the earth. But the supposition, though it seemed at first pretty allowable, is by no means to be admitted; for it would follow that the phenomenon was at least distant from us $\frac{1}{4}$ of the diameter of the earth, which is too great an altitude to be believed.

*A remarkable
one in New-
England,
Obs. 22. 1730.
By Mr. Isaac
Greenwood.
n. 418. p. 55.
March, &c.
1731.
† Vol. IV.
P. II. C. I.
§. xxvi.*

21. The aurora borealis has been very frequent with us of late; but none either for brightness, variety or duration, so considerable as that on the 22d of October, 1730. This meteor has been observed in N. England, at different times, ever since its first plantation; but I think at much longer intervals than of late years, and never to so great a degree as the present instance: nor indeed is there any recorded in the Phil. Trans. that I could think equal to it; excepting only that celebrated one of the 6th of March, 1711. † and in many respects that also must give the preference to this.

Obs. 1.] Octob. 22. 1730. 6^h 30' p. m. there lay near the horizon an extended dusky vapour reaching from N. W. by N. to N. E. by E. The upper edge was the segment of a circle, whose greatest height from the horizon was about 15° bearing nearly N. by E. Adjoining to this was a concentric segment of a very light azure, of a greenish cast, strongly illuminated, a few degrees in breadth, and then dilated more and more till it became blended with an extensive brightness, or aurora, which lay every where above it for about 45 degrees. There was in several places a faint cast of red. The heavens were every where else perfectly serene; a small westerly wind, and the moon above 80° below the eastern horizon.

Obs. 2.] At 6^h 35' two striæ rose perpendicularly from different parts of the illuminated edge of the vapour which I all along suppose to continue its figure, when there is no particular note to the contrary. These were of a faint red, and to the height of 45° at least.

Obs. 3.] At 6^h 40' the striæ were very numerous to the left, each about 45°; and one in the middle (by which I shall always mean the middle of the northern dusky vapour) rose to a surprizing height. It

was

was 8° or 10° in breadth; of a light azure tinged with green, and in several places streaked vertically with a bright flame-colour. There was also N. W. by N. a large area or body of a very intense red.

Obs. 4.] At $6^h 45'$ the whole extraordinary luminous. The red diffused in all parts above the greenish light, which now bounded the dusky vapour in the north; and indeed several parts of this were tinged therewith also. But the most intense red was towards the N. W. and N. E. by E. between which were various pyramidal streams of different colours, some blue, some green, others flame-coloured, &c. many tintured with, and all terminated by the diffusive rosiness. *Fig. 19.* One stria N. W. by N. was of a surprizing lustre, of a light azure turned upon green. This scene was very beautiful, the height of each column about 45° , and many of them well defined.

Obs. 5.] At $6^h 50'$ the enlightened part of the hemisphere was every where tinged with red; its horizontal bounds the same as before, but its altitude about 70° . Whence it appears the aurora is considerably extended upwards. The reddish cast on the right hand from N. to E. was beautifully distinguished into perpendicular striæ, which generally observed the following order of colours, beginning from the E. viz. a deep azure, which successively proceeded, to the lightest blues, though each column was so intense as to be distinguished from the neighbouring columns; after which followed several degrees of green, and then of red, the deepest being an intense scarlet. And this order was repeated several times, filling up the whole space from N. E. to N. by W. The western regions were at the same time of an undistinguished red. Many of the rising columns were very exactly terminated.

Obs. 6.] At $6^h 55'$ the red which in the last lay towards the zenith became very intense, darting to the horizontal vapour throughout the intermediate space innumerable striæ differently coloured. The horizontal dusky cloud was somewhat raised; a stratum of blue *Fig. 20.* just under it, which towards the horizon was of a fainter cast, as the colour of the sky is when overcharged with vapours. The upper surface of red jutted out irregularly in several places, though in general well terminated.

Obs. 7.] At $7^h 0'$ the distinguished red towards the zenith approaching nearer thereunto, is about 20° broad upon our meridian, and thence tapers to the E. and W. horizon. The whole appearance is of a reddish hue, in some places faintly streaked. At this juncture appeared E. S. E. considerably removed from the other phenomena, a remarkable oval, the transverse diameter erect, about 30° in length, and of a very bright azure. The whole scene very beautiful.

Fig. 21.

Obs. 8.] At $7^h 2^{\frac{1}{2}}$ the phenomena much the same, excepting that the reddish cast has risen, and is now diffused to the southward of the zenith. The other parts of the northern hemisphere much like the genuine aurora, interspersed with various small clouds. There are two distinguished parallelogrammic areas of an intense red, nearly 30° in diameter, the one to E. by N. the other to N. W. which is of the deepest colour, and crossed in the middle with a black bar. The bright azure oval still remains towards the E. S. E.

Obs. 9.] At $7^h 5'$ the whole appearance vanished, excepting that the northern regions retained the aurora, which was as bright as about half an hour after sun-set. The eastern area of red was distinguishable, though very faint, reaching from 30° to 50° high; also the former area to the N. W. somewhat more intense. This was the same as in the last article; and the black bar mentioned then appeared now to be a cloud moving eastward, part whereof was seen on this red area, and part to the north. And in this view the red vapour appeared vastly more distant than the cloud. There were several small spaces of light interspersed throughout the scene.

Obs. 10.] At $17^h 15'$ the appearance somewhat changed. The area of red N. W. was the most intense. Several rising columns of a faint red and blue between west and north. A deep red E. by N. Some of the fixed stars could all along be seen through all the colours that successively lay upon them, though with considerable differences as to obscurity and clearness, according to the intensities of the colours. No clouds in the southern regions.

Obs. 11.] At $7^h 20'$ the wind has been all along W. and W by N. and if the strongest winds be expressed by 10, this was sometimes 2, and I think, never less than unity. I am informed that at Boston, which lies about 3 miles E. it was all the while to the E. of the S. The aurora still of the same dimensions, but the edge of the dusky horizontal cloud much abated of its brightness and colour. There are four remarkable spots, or areas of red, one E. by N. one N. E. by N. very intense, as also another nearly N. and the last bore N. W. by N. which with that E. by N. has been of some considerable duration. There were several considerable striæ intermixed with red, and a flame-colour rising about N. N. W.

Obs. 12.] At $7^h 28'$ the redness about the N. increased in its dimensions and intensity very much. It reaches from the N. star to about 20° upwards, and for about 12° is exceedingly bright. It is distinguished into several perpendicular columns of various degrees of red, and many well terminated.

Obs. 13.] At $7^h 30'$ the redness N. E. by N. moves W. and is considerably altered in that respect. That about the N. star is now divided in the middle by a perpendicular column, very broad, and

of a very intense yellow light. It appears now that this also has a slow motion W. but the western redness has all along advanced at a considerable rate.

Obs. 14.] At 7^h 37' the three red areas just mentioned are now united, and nearly confounded with one another. The distinction is only as to the degree of redness. The aurora which lies partly under these is considerably abated of its lustre; and the horizontal bounds contracted to about 80°, though the altitude is rather encreased. The E. and W. limits seem still to approach one another very slowly. There was one stria very considerable, horizontally posited, and about 5° broad, of a bright flame-colour, reaching from the horizontal bounds throughout the whole meteor arch-wise, whose greatest height was about 15°.

Fig. 22.

Obs. 15.] At 7^h 45' the flame-coloured arch much diminished. The redness very evident, and continuous; though in some places of different intensities, and visibly increasing about N. by W. On each side of it a distinguished ruddiness.

Obs. 16.] At 7^h 51' the distinction of redness about N. by W. changed to a more intense uniform redness, which seemed to be by the union of the aforesaid distinguished areas; and the greatest intensity was in the middle space that was between them; viz. N. by W. At this juncture I was not a little surprized with an extraordinary flash of lightning very bright, which began about the midst of this congregated vapour and ran with an oblique undulatory motion for 20° towards the horizon.

Obs. 17.] At 8^h 1' the redness still continues, but much abated.

Obs. 18.] At 8^h 9' the meteor scarce to be distinguished but by the aurora, which reaches from N. W. to E. in such sort of curve that the highest part is due N. about 40° of altitude. There is still a reddish cast N. N. W.

Obs. 19.] At 8^h 30' the colours not very considerable; but the form entirely new. The breadth of the redness was from the pole star downwards about 20°; and from thence it run tapering on the left hand to W. by N. and on the right to the E. In which points it was of no discernible breadth. Its upper edge was of the deepest red, which dilated by degrees to a flame-colour, and could scarce be distinguished from the neighbouring aurora. However, there were two spots, one to the right, and the other to the left, in the extensive arch of a remarkable sadness.

Obs. 20.] At 9^h 20' was an exceeding beautiful appearance. From the zenith about 20° S. an uncommon redness was formed, as it were into a knot or canopy, very distinctly terminated (especially on the S. parts) about 20° in length, which lay E. and W. and little less in its dimensions N. and S. From this issued

Fig. 23.

Aurora Borealis.

issued innumerable striæ throughout the N. hemisphere and farther, the horizontal bounds being W. S. W. to E. S. E. These striæ were dispersed in an exact order, proceeding from the aforesaid knot as folds equally diverging, and each of the same colour and brightness throughout the whole space to the horizon. The order of the colours was very agreeable, interchangeably blue, red, and then flame-colour; each of which was also distinguished into striæ of various intensities, from the deepest blue to the lightest; from the bounds of violet, to a tincture of orange; and lastly, from the colour of the aurora to the brightest flames. And this order was repeated innumerable times throughout the whole scene. The whole was as bright, and in many respects resembled a series of rainbows vertically posited; and in this view the generality of people will always remember it. And indeed were the heavens to be disposed into innumerable rainbows, excepting only the greater number of primitive colours, it would scarce exceed this phenomenon in beauty: and the knot from whence it seemed to proceed far surpasses any of the redness of that meteor, and even blood it self. It may not be amiss to observe that the W. breeze has been for some time perfectly lulled; nor is there the least motion in any part of the heavens. The N. bank of vapours has all along continued, and now reaches from W. to E. by S. its greatest height about 8° .

Obs. 21.] At $9^h 35'$ the bloody knot wholly vanished; though several of the descending striæ remain entire, and in many places parts of others, all of the same direction, and a fainter colour than before. The sky is perfectly calm and serene.

Obs. 22.] At $9^h 42'$ the N. regions retain a bright aurora, interspersed with a reddish cast. From the zenith is diffused a very extensive red vapour, reaching to the S. near 30° from the zenith, and from thence converging towards the E. and W. horizon, where it meets the one E. by S. and the other W. S. W. The S. edge was of the deepest red, and the most distinguished redness W. S. W. There appeared a falling star S. W. of a considerable duration.

Obs. 23.] At $10^h 2'$ the meteor much advanced to the S. its greatest height being not above 40° from the horizon: its horizontal bounds E. S. E. and W. by S. Its redness much abated; but the aurora diffused every where throughout the scene, as conspicuous to the S. as towards the N. parts of the zenith; which was an uncommon sight. The sky was now remarkably hazy, and full of vapours.

Obs. 24.] At $10^h 18'$ the aurora advanced considerably to the S. of the red vapour, which now is much diluted, about 20° in breadth, a part of it at least 50° to the S. of the zenith, and tapering towards the E. and W. horizon, where the bounds are much the same as before.

Obs.

Obs. 25.] At 10^h 25' the aurora separated from the reddish vapour considerably in the upper parts, though joined in the horizontal, and not above 25° from the S. horizon. Not any distinguishable red to the N. but an arch of the aurora of much the same height, though much inferior in its horizontal measure. The S. and N. aurora each very bright. There were several temporary flashes in many parts of the red vapour. At this juncture the aurora seemed to appertain as much to the S. as N. horizon; and the redness considerably more. But there was a great difference just towards the horizons; the one being covered with the dusky vapour so often mentioned, and the other appearing of its natural blue. In the figure Z denotes the zenith, and N E S W the horizon. Fig. 24.

Obs. 26.] At 10^h 35' the appearance over, excepting a reddish cast to the E. and a faint aurora in the N. Regions, of but small extent from the dusky horizontal vapour.

Obs. 27.] At 11^h 35'. There have not been any remarkable phenomena since the last. The N. aurora with the dusky vapour still continue, and I think as evident as at any of the foregoing periods.

I am informed by some who were occasionally on the water that its beginning was just after sun-set, in the form of an extended darkish cloud rising N. a few minutes after the appearance of which there was towards the E. and W. regions a very distinguishable tincture of red. And the next change was my first observation.

Obs. 28.] At 11^h 45' it appeared in a new and very surprizing form. The edge of the horizontal vapour was strongly illuminated, as though it had been fired; and this was in height about 8°. From hence arose up continually, following one another, very extensive horizontal columns of a bright flame colour, which in scarce a second of time reached some to 40°, others above 60° of altitude. Each of these columns were as though an horizontal train of gunpowder had been suddenly fired, and the flashes regularly propagated to such enormous heights in an horizontal posture. And there were innumerable successions of these rising flashes, the phenomenon continuing near a quarter of an hour. Sometimes there were several of these flashes ascending together, at a little distance from one another, as though there had been several horizontal trains successively and almost instantaneously kindled after one another. Sometimes the rising line of light would be continued horizontally throughout the whole scene, in other places three quarters, an half, one third, a quarter, &c. of the same length, as though these trains had been unequally extended. Sometimes the flash would begin in the middle and run kindling to the extremes: then at one extreme moving towards the other; and at other times in more places than one. But in all these varieties the horizontal motions ceased and the whole became one uniform line before it had passed the enkindled edge of the cloud, which I have said was

Fig. 25.

Parhelia, or Mock-suns.

not above 8° . All which may be well represented by the aforesaid trains of inflammable matter, sometimes kindled in one place, sometimes in another, but always propagated through the whole train, with so swift a motion that there could be no considerable difference as to the height of one part above another. The greatest extent of these horizontal flashes was from N. W. to N. E. After these phænomena the meteor assumed its usual form; viz. a bright aurora settled upon a dusky horizontal vapour.

Obs. 29.] At 2^h the meteor was again formed into much the same form as in Obs. 20, but of fainter colours considerably. It vanished also again in the same manner.

Obs. 30.] At $6^h 30'$ the aurora continued 'till day-light; and the phænomena, at different times and without any certain periods, were much the same as described in one or other of the foregoing articles.

The day before this meteor was very warm for the season, though early in the morning there was a very considerable hoar-frost. The morning following was remarkable for an abundant dew. The temper of the air much the same as the preceding day. About 8 o'clock the heavens fair and calm. Barom. 30. 1. Therm. 10° .

In the figures I have attempted the stereographic projection of the most considerable scenes, which may be a great assistance to the imagination.

I have compared these observations with what I could find relating to the aurora borealis in the philof. transf. † &c. and think there are few particulars mentioned there, but what occurred in this wonderful instance; some that are rare confirmed, and a few altogether new; but the chief advantage in these notes, is the process, crisis, and decay so obvious in many of the most remarkable scenes.

† Vol. II.
P. II. C. I.
§. lxxvi, &c.
Vol. IV. P. II.
C. I. § xxiv,
&c.
The same observed at Annapolis in Maryland.
By Mr. Rich. Lewis.
ibid. p. 69.

22. Oct. 22. 1730. about six at night the N. part of the hemisphere appeared of a faint red, the horizon was very dusky, and this redness was bounded above by a very dark cloud.

As the night advanced this meteor reddened, 'till it was of as deep a colour as blood. It spread itself to the N. E. and continued all night, but about two in the morning I observed that it sent forth from its N. part two or three streams of a whitish colour which shot up to the zenith. These emanations looked much like the rays of the sun passing through a dark cloud, when it is said to be drawing water. I took it to be an aurora borealis, but it appeared much fainter than those I have seen in England.

Two Parhelia, an Arc of a Rainbow inverted, and an Halo. By Mr. W. Whiston.
n. 369. p. 212.
Sep. &c. 1721.

XXIII. 1. About 10 o'clock in the morning, Oct. 22, 1721, being at the house of Samuel Barker Esq; of Lyndon in the county of Rutland, after an aurora borealis the night before (wind W. S. W.) I saw an attempt towards two mock-suns, as I had done sometimes formerly. About $\frac{1}{2}$ or $\frac{1}{4}$ of an hour after, I went to view the heavens, and then found the appearance complete, and when Mr. Barker and others

others of the family were called, we all saw what we had none of us seen before, I mean two plain parhelia or mock-suns *Fig. 26.* tolerably bright and distinct, and that in the usual places, viz. in the two intersections of a strong and large portion of an halo, with an imaginary circle parallel to the horizon, passing through the true sun. I call this circle here imaginary, because it was not itself visible, as it sometimes has been at such appearances. Each parhelion had its tail of a white colour, and in direct opposition to the true sun; that towards the east was 20 or 25 degrees long; that towards the west about 10 or 12 degrees; but both narrowest at the remote ends. The mock-suns were evidently red towards the sun, but pale or whitish at the opposite sides, as was the halo also. Upon casting our eyes upward, we saw an arc of a curious inverted rainbow, about the middle of the distance between the top of the halo and our vertex. I mean this, when allowance is made for the usual inequality that appears between the same number of degrees nearer to and remoter from that vertex. This arc was as distinct in its colours as the common rainbow, and with the like allowance as before of the same breadth. The red colour was on the convex, and the blue on the concave of the arc, which seemed to be about 90 degrees long: its center in or near our vertex. On the top of the halo was a kind of inverted bright arc, though its bend was not plain. The lower part of the halo was among the vapours of the horizon and not visible. The angles especially as more exactly measured on the 23d near noon, when the same appearance returned again, but more faintly, were as follows: sun's altitude $22^{\circ} \frac{1}{2}$; perpendicular semidiameter of the halo $23^{\circ} \frac{1}{2}$; distance of the rainbow from the top of the halo $23^{\circ} \frac{1}{2}$; semidiameter of the arc of the rainbow, if our vertex be supposed its center, 21° . The phenomenon lasted each day for an hour and an half, or two hours. What was most remarkable on the 23d was that the wind, which on the 22d had been almost insensible, was now become sensible and changed to N. N. E., that the halo was sensibly become oval, its shorter axis parallel to the horizon, and the two mock-suns which were then but just visible, especially that on the east, were not in the halo, but a degree or two without it, which I ascribe to the unusual shortness of the horizontal diameter, which position of the mock-suns does not appear to have been hitherto taken notice of by any, though it was now very sensible.

October 26. as I was coming in the Northampton coach towards London, about 9 o'clock the halo returned larger and clearer than before, and the two mock-suns just attempted an appearance therein as on the 22d; but the air becoming thicker and thicker towards rain I saw them no more. I add nothing to this account but only that Aug. 30. before, I saw at the same place (Rutland) a remarkable halo, whose upper part had its inverted arc reddish within

Parhelia, or Mock-suns.

and pale without, but brighter and more vivid than ever I saw in my life: that we had there Sept. 11. in the evening, the lightest and most remarkable aurora borealis with its unaccountable motions and removals that ever I saw, excepting that original one March 6, 1718: that it was seen in Northamptonshire, at the Bath, and elsewhere: that the vertex of the columns which shot upwards was not our vertex, but evidently 15 or 20 degrees distant towards the S. and that the wind was in Rutland N. as I observed myself; at the Bath W. as Mr. Molyneux observed; and as I am informed by Sir Robert Clarke, in Northamptonshire S. all at the same time; which deserves particular reflection.

*A Parhelion
near London.
By Dr. Edm.
Halley.
ibid. p. 211.*

2. October 26, 1721, being on the river coming up to London, about half an hour past ten, the sun about twenty degrees high, I observed a circle about the sun, which is by no means unusual, when the air in chilly weather is replete with snowy particles; which circle was of the size it always appears in, about 23 degrees from the sun, and faintly tinged with the colours of the iris. When this circle happens I always look out to see whether any other of the phenomena that sometimes attend it appear, such as parhelia and other coloured circles concentric with the sun, and sometimes, as once I saw it, excentric; as also a white circle round the zenith, in equal altitude with the sun: but this time the air being thickened with a hazy vapour and the smoke of the town, I could only see to the eastward a luminous white patch, which for about twenty minutes shone through the thick air very conspicuously, of about two degrees diameter, as near as I could estimate it, and about the same altitude with the sun: and from it towards the sun there seemed to proceed a long white tail, much narrower than the mock-sun, but which I took to be a segment of the white circle which I once saw entire in London.

Had the air been clear I doubt not but much more of the phenomena of the parhelia might this time have been observed.

*Two Parhelia
in Ireland.
By Arthur
Dobbs, Esq;
n. 372. p. 89.
June, &c.
1722.*

3. Mar. 22, 1722. about half an hour after 5 in the afternoon nearly I saw a distinguishable parhelion, the wind and carry of the clouds about N. and by E. the sky in several places obscured with light clouds, and the sun entering into one somewhat more watry, yet so as to distinguish its disk. At first appeared below the sun, breaking out of the cloud, such rays as are usually seen in an evening, in a sky interspersed with clouds. In a little time appeared at the same height with the sun, as near as I could guess, having no instrument, a luminous spot, about four times the largeness of the sun's disk, and about 30° distant from the sun to the southward, which was covered with the lively shades of red and yellow on the side next the sun, and increased in splendor so as scarce to be borne by the naked eye, 'till it exceeded the brightness of the sun, which was then under a thin cloud, so as easily to perceive

his

his disk. After this had appeared about 3 or 4 minutes, finding it to be a real parheliion, I began to look about for the halo they generally appear in ; and as I observed some rays resembling a glory to point upwards from the sun, I saw in those rays at the same distance (being as near as I could guess about 30° perpendicularly above the sun) the colours of the halo appearing as in the luminous spot ; but instead of finding it as I expected in a circle surrounding the sun, it was inverted, yet not circular, but making an obtuse angle, the point towards the sun. I then looked to the N. of the sun, and as the cloud which was thicker on that side moved S. a luminous spot began to appear at the same distance from the sun as the other, and in the same parallel of altitude, which had the same colours towards the sun, and encreased in brightness, but did not come up to the brightness of the other spot, yet was as luminous as the sun then appeared : this spot was very little bigger than the sun's disk. As the cloud moved on, 'till it came to about 60° to the southward of the sun, and 30° from the spot, at an equal height there appeared another spot tinged with the colours of the rainbow. The whole appearance lasted a quarter of an hour. The reason of my not seeing the halos which generally appear with them was, that there was a good deal of clear sky above the sun, and the cloud was too thick below it. Having been only out occasionally, without any instrument to compute the proportions or take angles, my observations cannot be very exact. However, I can recollect nothing material that I have omitted.

- A. The place of the sun nearly W. about 12 or 13° above the horizon, being about an hour before sun-set. *Fig. 27.*
- B. The luminous spot, being about 30° to the S. of the sun as near as I could compute, having no instrument to take the angle, and in the same parallel of altitude ; the spot was not so well defined as in the scheme, being more imperceptibly shaded off in the cloud, the two semicircular lines next the sun were those tinged with the colours ; the nearest the sun being of a deep scarlet, the inner one a deep yellow, both the colours being softened as they fell off from the sun, all the rest of the spot being an intense light, so as the naked eye could scarce bear it.
- C. The other spot to the N. which appeared sometime after that marked B, being not quite so large, nor the colours so intense, but the same way disposed, those next the sun being red, the next yellow, and the rest white.
- D. A spot in the cloud as it moved S. 'till it came to about 60° distance from the sun, which had the colours as in the other spots, that next the sun being red, the next yellow, but much fainter than in the parhelia.

E. The

Parhelia, or Mock-suns.

E. The appearance of two segments of circles at about the same distance from the sun as the parhelia, being perpendicularly above it, the colours fainter than in the parhelia but the same way disposed, the lower lines next the sun expressing the red, and the upper the yellow.

The colours at D and E, as they were not so intense, neither were they quite so broad as those at B and C; the two colours being added together were about $\frac{1}{4}$ of the disk at B, and the colours in the same proportion at C; the diameter of the parhelion at B being about double the apparent diameter of the sun, as near as I could compute.

The centres of the segments of the halos marked E, if not in the parhelia, were very little below 'em.

Below the sun and parhelia the cloud was too thick to discover any thing through it; and above them 'till near the segments marked E. the sky was serene and nothing obscured; but at E. where the rays which pointed upwards from the sun terminated, it appeared hazy and so thick as to reflect the colours.

Four Parhelia. By Mr. G. Whiston. n. 398. p. 257. April, &c. 1727. Fig. 28.

4. March 1, 1727. walking in a garden at Kensington, about a quarter after 10, I happened to observe the following appearances.

I at first took notice of the halo about the sun, V M, with its usual circumstances which are pretty frequent; the upper part of it was very luminous, having a confus'd mixture of the rainbow colours in it, and being touched at the vertex with two other curvatures, OVR, NVT, in the situation which the scheme shews; though the latter arch NVT, did not appear 'till sometime after. The bottom part of it also at M, which appeared a little above the horizon, had something of the same nature, but not in so great a degree.

I perceived presently likewise the two parhelia, A, B, whose diameters were pretty large, and whose brightness and colour was pretty much as the upper part of the halo.

As the halo was at that time not quite perfect, but had some parts interrupted, I thought that the two parhelia were in the circumference of its circle, as usual; but after about a quarter of an hour, I directly observed the halo to pass between the parhelion A and the true sun; and I have no reason to doubt the same of the other B also, though I do not remember that I directly observed that.

The parhelia A, B, therefore, which were but a little distant from the circumference of the halo, began now to appear with narrow, pale, whitish streaks of light, in the nature of tails proceeding from them; but soon extended themselves so far, that they met in the point opposite to the sun, and formed the great circle ABCD, parallel to the horizon, whose breadth was about half that of the halo.

Upon viewing it carefully all round I soon discovered a third mock-sun C, of a plain whitish light, without any mixture of colours, which was also the case of the whole great circle; and presently also a fourth

D.

D, both of them pretty exactly resembling each other (as the two first did themselves likewise) very much inferior to the parhelia A, B, in brightness, though not so much in magnitude; for I estimate their diameters to have been to the two first parhelia as 4 to 5.

As I had no opportunity of measuring the several angles, I have placed the mock-suns, C; D, in the scheme, rather in agreement with former observations than my own guesses; for they appeared to me to be at a greater distance from each other, and nearer respectively to the two first parhelia, which difference M. Huygens attributes to the different altitude of the sun.

The arch, NVT, not being very visible while the great circle was, and indeed not extending itself at any time near so far as to the parhelia, or the circumference of the great circle, I could not determine by a direct observation whether the parhelia A, B, appeared in the intersection of that circle produced with the great circle; but the curvature appeared to me so plainly different from that, its center not being, I reckon, above M, that I cannot but believe the parhelia A, B, were neither in the intersection of NVT with the great circle A B D C, nor of the halo with the same circle, in one of which circumstances they have hitherto appeared; but between those two points and much nearer to the circumference of the halo.

I thought I saw plainly at one time likewise, a small portion of a secondary halo, if I may so call it, as in the scheme at P. It seemed evidently to be an arch of a circle concentric with the halo, and tinged with the rainbow colours, whose diameters might perhaps be to that of the halo, as 4 to 3; but as it appeared but for a little time, I would not be positive about it.

I do not at all remember, that during the time I watched it, I ever observed the great circle A B D C, to be visible within the halo, between A, and B, though all the other part of it was sometimes very perfect.

This face of the heavens continued, though with an interruption of some parts now and then, 'till about a quarter after 11, when I left it, and could not return 'till about 12, at which time this phænomenon was no longer visible, the sky being clouded over which had been before only hazy, a sure criterion of these appearances.

5. Martij die 11, 1725. circa hor. 9. matut. ☉ inter tenues nubes allucens, & colorato halone cinctus, in eo ad dexteram & lævam duo parhelia efformabat multum resplendentia. Duravit spectaculum per semihoram.

Two in a Halo at Pekin.
By F. Ignace Kögler. n. 405. p. 553. Nov. 1728.
A Rainbow seen on the ground. By Dr. Ben. Langwith to Dr. Jurin. n. 369. p. 229. It Sep. &c. 1721.

XXIV. 1. Sept. 7. 1721. about nine in the morning I was riding with some friends over Port-mead near Oxford. The morning had been misty and the grass was very wet with the dew. We had not been long out before the air cleared up and the sun began to shine very bright. We soon after had the satisfaction of seeing a rainbow upon the ground, whose colours were very near as lively as those of the common iris.

Arches of colours contiguous to

It was extended upon the ground for some hundreds of yards, and the colours were so strong that it might have been seen much farther had it not been terminated by the bank and hedge of the field: It is hardly worth while to observe that it continually changed its place as we moved along, since this is no more than happens in other rainbows. The more remarkable particulars were these:

First, The figure of it was not round, but oblong; being as I conceive, a portion of an hyperbola.

Secondly, The convex part of it was turned towards the eye, and the vertex was at a small distance before us.

Thirdly, The colours took up less space, and were much more lively in those parts of the iris that were near us, than in those at a distance.

These phaenomena may easily be accounted for, by comparing this iris *DEC*, with the common iris *keiE* formed by drops falling in the air at a small distance from the eye of the spectator, *H*, and touching the ground with the lower part of its arch in *E*, the vertical point of the iris *DEC*. Produce the cone *Hie kE*: its intersection with the plane of the horizon will give the figure of the iris *DEC*. Hence it follows,

First, That as the angle *eHG* happens to be greater, equal to, or less than 90 deg. the figure will be an hyperbola, parabola, or ellipsis.

Secondly, That as the sun was about 30 deg. high when we viewed the phaenomena, the iris was an hyperbola.

Thirdly, That the arches of the same iris, consisting of colours of different refrangibility, may also in some cases be different sections of the cone.

Fourthly, That since the angle *eHF* is always given; from the height of the point of view *HG*, and the sun's altitude *SLA*, the dimensions of these iris's are easily determined.

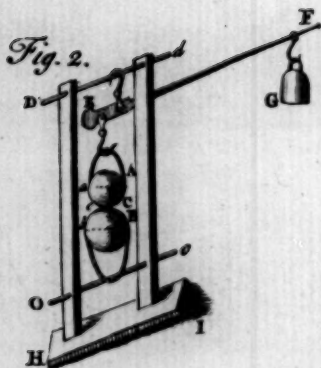
2. When the primary rainbow has been very vivid, I have observed in it more than once a second series of colours within, contiguous to the first but far weaker, and sometimes a faint appearance even of a third. These encrease the rainbow to a breadth much exceeding what has hitherto been determined by calculation. I remember I had once an opportunity of making an ingenious friend take notice of this appearance, who was much surprized at it as thinking it not to be reconciled with the theory.

One evening lately a little before six, Wind at N. W. by W. we had here a lively, distinct, primary rainbow, the inner and purple colour of which had a far greater mixture of red in it than I could ever observe in Sir Isaac Newton's oblong spectrum. Under this was a space, of a breadth considerably less than that of the limbus of the rainbow, in which I could not distinguish any colours. Still lower was a faint interrupted arch of red, enclining to purple, which appeared and vanished several times while I was intent upon observing it.

My

Fig. 29.

*Arches of
colours conti-
guous to the
inner edge of
the rainbow.
By the same
to the same.
n. 375. p. 241.
Jan. &c.
1723.*



Bulb
A
Weight
Bulk = 8000
Weight = 8000

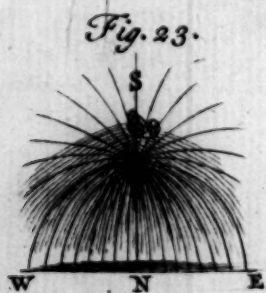
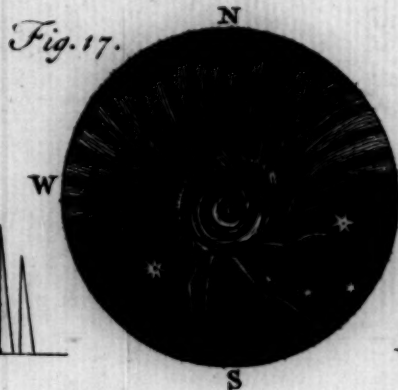
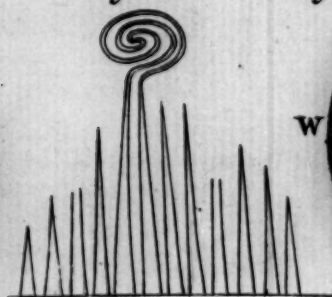
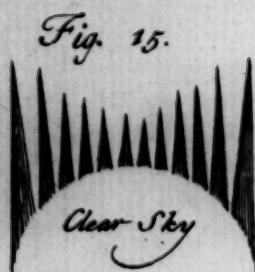
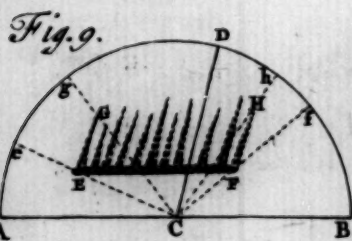


Fig. 4.

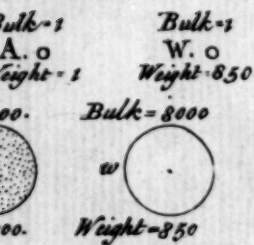


Fig. 5.

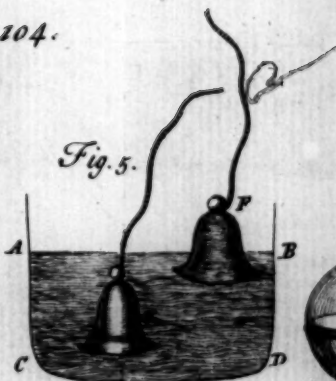


Fig. 6.

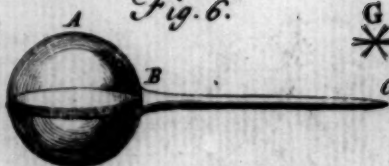


Fig. 7.



Fig. 13.

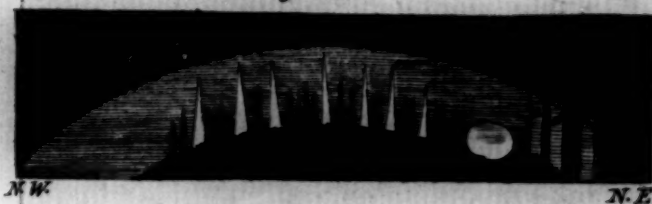


Fig. 14.



Fig. 18.



Fig. 19.



Fig. 20.



Fig. 21.

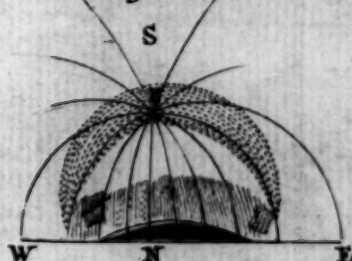


Fig. 26.



Fig. 27.



Fig. 28.

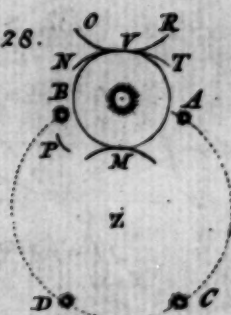
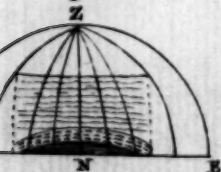


Fig. 25.



My suspicion about this phaenomenon is, that the extraordinary redness in the purple of the first rainbow is owing to the mixture of the red rays of a second series of colours with the purple rays of the first; that the colourless space consisted of rays which are too weak to affect the sight with distinct colours; and that the innermost broken arch was the ending of a second and beginning of a third iris. As I here saw the purple of the second iris without the other colours, so I have seen the other colours, but not very distinct, without the purple: but I could never see more than one series of colours near the horizon.

March 26. 1722. in the evening, about a quarter before six, Wind S. W. we had one of the finest rainbows that ever I beheld. The first series of colours was as usual, only the purple had a far greater mixture of red in it than I have ever seen in the prismatic purple: under this was a coloured arch, in which the green was so predominant that I could not distinguish either the yellow or the blue. Still lower was an arch of purple like the former highly saturate with red, under which I could not distinguish any more colours. I had the pleasure of viewing this delightful object for a considerable time, without that vanishing and returning of colours described in the last paragraph. The order of the colours in this compounded rainbow was red, yellow, green, blue, a mixture of purple and red, green, (or rather a mixture of yellow, green, and blue) a mixture of purple and red.

I begin now to imagine that the rainbow seldom appears very lively without something of this nature, and that the supposed exact agreement between the colours of the rainbow and those of the prism is the reason that it has been so little observed.

Aug. 21. about half an hour past 5 in the evening, weather temperate, wind at N. E. the colours of the primary rainbow were as usual, only the purple very much inclining to red and well defined: under this was an arch of green, the upper part of which enclined to a bright yellow, the lower to a more dusky green: under this were alternately two arches of reddish purple and two of green: under all a faint appearance of another arch of purple, which vanished and returned several times so quick, that we could not steadily fix our eyes upon it. Thus the order of the colours was

I. Red, orange colour, yellow, green, light blue, deep blue, purple.

II. Light green, dark green, purple.

III. Green, purple.

IV. Green, faint vanishing purple.

So that we had here four orders of colours, and perhaps the beginning of a fifth, for I make no question but that what I call the purple is a mixture of the purple of each of the upper series with the red of the next below it, and the green a mixture of the intermediate

colours. I write not this barely upon the credit of my own eyes; for there was a clergyman and four other gentlemen in company, whom I desired to view the colours attentively, and all agreed that they appeared in the manner now described.

There are two things, which will deserve to be taken notice of, as they may perhaps direct us in some measure to the solution of this curious phenomenon.

1. That the breadth of the first series so far exceeded that of any of the rest, that as near as I could judge it was equal to them all taken together.

2. That I have never observed these inner orders of colours in the lower parts of the rainbow, though they have often been incomparably more vivid than the upper parts under which the colours have appeared. I have taken notice of this so very often that I can hardly look upon it to be accidental, and if it should prove true in general it will bring the disquisition into a narrow compass; for it will shew that this effect depends upon some property which the drops retain whilst they are in the upper part of the air, but lose as they come lower and are more mixed with one another.†

† *Vid. supra*
P. I. C. III.
§ iii.
Effects of
damps. By
Mr. Isaac
Greenwood.
n. 411. p. 184.
Oft. &c.
1729.

XXV. 1. July 19. 1729. Mr. Adams and his servant being employed to repair a pump in Boston, N. England, uncovered the well about 6 afternoon; upon which Adams immediately attempted to go down by a single rope, but had not descended above five or six foot before he was rendered incapable of sustaining his weight, and without speaking, or any signals of distress, slipped down suddenly to the upper part of the joint of the pump; where being supported about a minute, fetching his breath in a very distressed manner, he fell to the bottom, which was about eight or ten foot lower and covered with but a very few inches of water, without discovering any signs of life. Hereupon his servant with great precipitation took the rope in his hand in order to descend to the relief of his master; but at the same distance from the top met with the same fatal interruption; and without discovering any signs of distress was heard to fall to the bottom. The workmen above prepared a third with a tackle about his waste. Upon his descent he was rendered speechless and made no signs at all, though he had agreed to it; whereupon being raised from the well he was found to have the image of death impressed upon him; but by the use of proper means was soon recovered, without remembering any thing particularly that had passed. Some hours after this the other bodies were taken up; but, as we had before been well assured it would be, with all the marks of a violent death upon them.

There is nothing particular relating to this well, excepting that it is situated near the town-dock, the reservoir of all the dregs of the neighbouring streets, and about 30 foot deep, which in this place is so considerable that it is lower than the surface of the water at the greatest ebb.

ebb. There had not been an air-tube, or passage for the external air to communicate with it for some considerable time.

In the evening several trials were made by letting down lighted candles uncovered, others enclosed in lanthorns, and others with the lanthorn placed in a pail; but in all these endeavours it was observed, that whatsoever the circumstances of the descending light were it never reached above six foot.

July 20. I repeated this evening such experiments in the damp as related to flame, and found the effect much the same as before; viz. in about 6 foot below the top of the well the flame would grow dim, and if not immediately raised would change to a bluish colour, and become more and more contracted or diminished, 'till in about a minute's time it would be totally extinguished without any remains or stench accompanying the wick. In these experiments I particularly observed that the flame in all its changes still continued its pyramidical figure; nor did a quicker or slower descent make any alteration in these circumstances. One experiment was very particular, relating to the flame of a candle. We took a common pail, and having fixed a candle to the bottom thereof, erect, about 8 inches long, we poured in as much hot water as reached within a quarter of an inch of the blaze of the candle. Then having carefully lowered the pail down the well, the flame, notwithstanding it was defended by the reeking steams of the hot water, went out at the same depth and in the same time as before. After this we immersed burning coals, flaming brimstone, and lighted matches, all which were extinguished with very little difference as to the time or other circumstances.

Two experiments were made relating to animal life. A large kitling was very much affected in about a minute's time; and after three minutes was rendered so weak, that when she was taken out she could not sustain her weight on her legs. Being at length pretty well recovered, we carefully bound her up in a silk handkerchief that she might be the more easily suspended; and having let her down about 16 or 18 foot, in three minutes she was affected in the like manner as before, making a very distressed noise, and in about five minutes was in such extraordinary convulsions as rendered the sight not a little disagreeable; but in these throws she disengaged herself from the handkerchief and fell to the bottom, without making any efforts to swim; whence we concluded they were the last struggles for life in which she broke loose.

We tried the same fatal experiment upon a small bird, which being suspended in the damp about three minutes was found entirely senseless, and according to all appearance past recovery. Upon taking it in my hand I found it was very cold, nor had it the least motion that I could discover; however, keeping it close between my hands which were pretty warm, in about a minute I felt a small palpitation, which

Effects of Damps.

presently encreased to a stronger pulse, 'till in about six or seven minutes the bird was restored to a perfect and uninterrupted respiration. About half an hour after this we again put the bird into the damp, and continued it there about five minutes, after which we found it past recovery.

July 21. I repeated several of the experiments relating to lights and flame, which succeeded with very little if any alteration as before. This we looked upon as an undoubted confirmation of the continuance of the damp: whereupon we first examined the elasticity of the air in the well by letting down a small bell, the sound of which was as distinct and loud as in any ordinary well of the same depth.

Then to discover the degree of moisture, we took a large sponge a little wet, which with the silk string whereby we let it down weighed 278 grains. This being suspended in the damp upwards of five minutes and then raised was carefully weighed, and found to be of the same weight precisely. After this we dried the sponge, which then weighed but 261 grains, and having applied it to the damp for the space of ten minutes, we found also that it had not gained the least part that could be perceived in its weight. Also a large bundle of cat-gut, weighing two ounces fifteen penny-weight, ten grains, acquired not the least augmentation by being suspended for a very considerable time.

To these experiments we added one upon the hydrostatical balance, in order to determine whether there was any extraordinary difference as to the density or specific gravity of common and this vitiated air. The balance we made use of was very large and accurately poized, and the solid, which was a globe, was four inches eight tenths in diameter. This with its string weighed in the air seven ounces six penny-weight. And after we had immersed it in the damp it lost nothing of its weight, being then in æquilibrium to so great a degree of exactness that half a grain would over-ponderate on either side.

This damp abated more and more by being exposed to the air, 'till on July the 25th persons were let down to the bottom without any inconvenience.

There happened another instance of a very sudden subterraneous vapour, on May 9, 1729, in another well in Boston.

This well had been opened for some considerable time; and not only enlarged in its diameter but sunk 14 or 15 foot deeper. Hereupon Mr. Rennie and a young man whose name was Russel undertook to lay the stones. They had been employed all the day 'till about six in the afternoon, when Rennie perceived a very unusual stench, of which he first accused his partner, 'till by its extraordinary encrease he became apprehensive of some greater danger. Russel was hitherto unsensible thereof, but perceiving his partner's visage change to a very uncommon degree, called up for relief; at which instant, as he

he afterwards expressed himself, he first perceived a very strong noisome smell like that of rotten fish, which on a sudden seized his senses and rendered him unable to sustain his weight. Rennie had immediately closed his mouth and nostrils with his hand; and when the bucket was lowered with a third person for their relief, assisted in getting Russel into it. As the bucket was raising, Russel was taken with very unusual and extraordinary fits; and when he was laid upon the ground 'till Rennie was taken out, could scarce be kept still by the united strength of three or four persons; bounding and writhing his body, like a fish newly taken from the water. Rennie was affected only with fainting fits. After three hours Russel recovered of these extraordinary convulsions, but was disordered in his brain during the whole night; and though Rennie was sooner relieved of his fits, he continued extreamly disordered for a longer time. It was thought remarkable that neither of them was affected with either vomiting or purging.

This accident happened on friday, and on the monday they were restored to perfect health. The well continued infected for a very little while, and when on the monday following some other workmen renewed the work, nothing noisome could be perceived.

I cannot call to mind that there is any instance recorded of such a transient vapour or damp, and must confess I am at a loss how to account for it. Should there be subterraneous exhalations which, like the clouds or wind in the atmosphere, shift from one place to another, it might be of great importance to observe the particulars thereof, especially such as are malignant as this was. The passage of this vapour was about 25 foot below the surface; a depth too great for it to affect cellars or vaults. The part of the town where the well is lies very high; the ground for about 10 foot is hard clay, and the rest a coarse sand and gravel.

2. The engine consists of a triple crank working three pumps, which both suck and force air, by means of three regulators, and are alternately applied to drive air into, or draw it from any place assigned, through square wooden trunks; which being made of slit deal, and 10 inches wide in the inside, are easily portable, and joined to one another without any trouble.

Exp. 1.] I filled a tall cylindric glass with the steams of a burning candle and burning brimstone matches, so that a lighted candle would go out almost as soon as it was let down into it. Then fixing the trunks to the forcing hole of the engine, I drove fresh air into the bottom of the above-mentioned receiver; so that the foul steam came out at the top of the receiver.

Exp. 2.] Having filled another receiver (close at top) with foul steams, as before, I placed it in a position almost horizontal, only with the

Experiments with an engine to draw damps or foul air out of mines. By Dr. J. T. Desaguliers. n. 400. p. 353. Oct. &c. 1727.

To draw damp out of mines.

the close end something above the open end, that the foul steam might not go out of it self when specifically lighter than common air. I fixed the trunks to the sucking-hole of the engine; and by working the engine drew out the foul steams from every part of the receiver, as the trunks were applied to them successively.

Exp. 3.] Having filled with foul steams and set upright the cylindric open receiver, I applied the trunks to the sucking part of the engine with their open end near the bottom of the receiver. Then, by pumping, the steams were all drawn downwards, and so out through the trunks.

Exp. 4.] Having set a candle in the cylindric receiver above-mentioned, without having filled it with steams, and let down the trunks into the receiver below the flame of the candle, I laid the wet leather over the mouth of the receiver, leaving about half an inch open for the air to come in; notwithstanding which the candle began to dwindle and was ready to go out; but working the engine with the trunks joined to the forcing part, the candle revived, and burned at last as well as in the open air. When I had left off pumping the flame of the candle diminished again; but when it was ready to go out it revived again upon forcing in more air with the engine.

When damp in mines are specifically lighter than common air, they will be driven out of the mine by the first experiment.

When damp are specifically heavier than common air, they may be sucked out by the second or third experiment.

When a fough, or adit, is carried from a mine to any distant valley, to discharge the water or save the trouble of raising it quite to the top of the pit, shafts or perpendicular pits are generally sunk from the surface of the earth to the said fough, to prevent the workmen from being suffocated as they dig the fough, and that at a great expence; but by exper. 4. fresh air may be driven down to the workmen to continue their breathing free and safe and to keep in their candles; by which means the expence of perpendicular shafts will be saved.

It has been found by several experiments that a man may breath a gallon of air in one minute, and a candle of six in the pound will burn nearly as long in the same quantity of air; so that a large engine will abundantly supply air for the burning of candles and the working of a great number of men in a mine.

The engines work with a great deal of ease, because no pressure of atmosphere is to be removed; only a velocity to be given to one sort of air to change it for another.

Fire will not do in all cases, though in some it will draw foul air out of mines with success; because several sorts of damp extinguish fire, and some fulminate and are dangerous when fire comes near them; and even in common stagnant air fire will not keep in long.

To measure the depth of the Sea.

III

Large bellows have sometimes been made use of for this purpose; but they require a much greater power to produce the same effect, and cannot have the advantage of being immediately changed from forcing to sucking; neither are they so cheap as the proposed engine, which may be all made of wood, except the crank which must be of iron, and the barrels of very thin copper.

XXVI. Papers omitted.

1. *Invitatio ad observationes meteorologicas communi consilio instituentas.* A Jacobo Jurin, M. D. n. 379. p. 422.

2. A new method for composing a natural history of meteors. By Mr. Isaac Greenwood. n. 401. p. 390.

XXVII. Accounts of books omitted.

1. Jo. Frid. Weidler's *observationes meteorologicæ, &c.* Ann. 1728 & 1729. n. 412. p. 250.

2. Mr. Mark Catesby's essay towards the natural history of Carolina and the Bahama Islands. By Dr. Mortimer. n. 415. p. 425.
n. 420. p. 174.

C H A P. II.

Hydrology.

I. **T**HERE have been several machines contrived for measuring the different depths of the sea; but as they consisted of two bodies (the one specifically lighter, and the other specifically heavier than water) so joined together, that as soon as the heavy one came to the bottom the lighter should get loose from it and emerge; and the depth was to be estimated by the time of the fall of the compound body from the top to the bottom of the water, together with the time of the emerſion of the lighter body, no certain consequence could be drawn from ſo precarious and complex an experiment. For even in ſtill water and in the ſame place, the time will hardly be the ſame in two experiments: much leſs will this machine answer in the ſea, on account of waves and currents and many other hindrances.

But as the preſſure of fluids in all directions is always the ſame at the ſame depth, a gage which exactly diſcovers what the preſſure is at the bottom of the ſea, will ſhew what is the true depth of the ſea in that place; whether the time of the deſcent of the machine be but a minute or two, or twenty times as long.

The Rev. Mr. Hales, in his *Vegetable Statics*, deſcribes his gage for eſtimating the preſſures made in opaque veſſels; where honey being poured upon mercury in an open veſſel riſes upon the ſurface of the mercury as it is preſſed up into a tube whoſe lower orifice

CHAP. II.

A machine for measuring the depth of the ſea with expedition and certainty. By Dr. J. T. Deſaguliers and Mr. Steph. Hales. n. 405. p. 559.
Nov. 1728.

To measure the depth of the Sea.

PART II. is immersed into the honey and mercury, and whose top is hermetically sealed. Now as by the pressure the air in the tube is condensed and the mercury rises, so the mercury comes down again when the pressure is taken off, and the honey (or treacle which does better) that is upon the mercury, sticking to the inside of the tube, leaves a mark which shews the height to which the mercury had risen, and consequently what was the greatest pressure.

My contrivance therefore is a machine which will carry down Mr. Hales's gage to the bottom of the sea, and immediately bring it up again.

Fig. 30.

A B is the gage bottle.

Ff the gage tube cemented to the brass cap of the bottle at G. with its open end f immersed in the mercury C. which by the pressure of 32 foot of water is carried up to d with a little treacle or honey d upon it, raised up from D a small thickness of treacle poured upon the mercury.

When the pressure of water is from a depth of 64 foot, the mercury and treacle rise up to E $\frac{1}{2}$ of the height of the tube; and so higher proportionably to the depth.

K is a weight hanging by its shank L in a socket m fixed to the ring M B cemented at the bottom of the bottle. When the hole L of the shank is shoved up to m the catch l of the spring S holds it from falling out of the socket, whilst the machine is descending. But as soon as K touches the ground at the bottom of the sea, the hole L rising, the catch flies back and lets go the weight, as in the figure. Then the empty glass ball I (which at sea may be a hog's bladder) rises up to the surface of the water with the machine, in which observing how high the inside of the tube is daubed, the pressure and consequently the depth of the sea is known.

H G is a brass tube to guard the top of the gage tube.

There are holes at F, G, and E, to admit the water to pass freely every where.

Of this sea-gage I made an experiment in the following manner. Having poured some quicksilver into the bottle of the gage, I poured upon it treacle to the depth of half an inch, then screwed on the brass cap of the bottle to which the glass gage-tube was cemented; by which means the open end of the tube was brought under the surface of the mercury, the sealed end being upwards. The machine thus fitted was immersed in a cylindric vessel of water, which with a plate at top was pressed between two pillars, in such manner that air might be condensed over the water without escaping. Then having forced in so much air with a syringe, as to lay on a pressure equal to what would be in a depth of 40 foot of water, I opened the cock of the upper plate, let out the air, and upon taking out the machine it appeared how high the quick-silver had risen in the gage-tube by the greasy mark which the treacle left within.

II. Cape

II. Cape Spartel and Cape Trafalgar from the western ocean are known to make the Streights mouth, from whence a current in the middle of the channel, which is about 5 leagues broad betwixt the Barbary and Spanish land, runs at least two miles each hour as far as Ceuta point; and there the two coasts opening about 18 leagues distant from each other, the current does not run above one mile an hour, and so continues as far as cape de Gat, which is 70 leagues up the mediterranean. Our mariners observe a current to set to the western sea, or the great ocean from Ceuta along the Barbary shore; and from Gibraltar along the Spanish shore; but that on the Barbary shore is generally their common rout, not only as being the freeest from rocks and less dangerous, but by reason that the tide is much stronger than it is on the other side, and helps their ships the sooner out of the Streights, which are the narrowest betwixt the points of Gibraltar and Ceuta; at which last place a neck of land extends itself a considerable way into the sea; and 'tis my opinion, and that of others, that whereas the current runs two miles an hour against this neck of land, the water there meets with so violent an opposition in its course, as occasions it to rebound with so much force, that part of it returns back along the same coast, and so out of the Streights mouth; which, with the small tide that sets out on the Spanish shore, it is believed, may exhaust a considerable part of that current which continually sets in to the eastward at the rate already mentioned. What I look upon to be very remarkable is, that in the year 1712 Monsieur de L'aigle, that fortunate and generous commander of the privateer called the Phoenix of Marseilles, giving chase near Ceuta point, to a Dutch ship bound for Holland, came up with her in the middle of the Gut or Streights betwixt Tariffa and Tangier, and there gave her one broad side which directly sunk her, all her men being saved by the means of Monf. de L'aigle; and a few days after, the sunken ship with her cargo of brandy and oil arose on the shore near Tangier, four leagues at least to the westward of the place where she sunk, and directly against the strength of the current; which has persuaded many men that there is a recurrency in the deep water in the middle of the Gut, that sets outwards to the grand ocean, and possibly a great part of the water which runs into the Streights does return that way and along the two coasts, as I have already mentioned; otherwise this ship must of course have been driven towards Ceuta, and so upwards. I was at Gibraltar when this happened, where I saw above 100 of the butts of that cargo of brandy which were sent thither from Tangier; I likewise spoke with the captain of the Dutch ship, who told the governour, myself, and many others, where his vessel sunk; and her rising afterwards at Tangier appeared very unaccountable to us, as it does to me to this day; for there's no doubt but the ship sunk where the Dutchman told us, since the Spaniards from the land, who saw it, confirmed it to us. The water in the

Of the currents at the Streights mouth. By Capt. Communicated by Dr. Hudson. n. 385. p. 191. Off. &c. 1724.

Of the tides in the river Thames.

Gut must be very deep, several of the commanders of our ships of war having attempted to sound it with the longest lines they could contrive, but without finding any bottom.

An account
of the tides
in the river
Thames. By
Mr. Hen. de
Saumarez.
n. 393. p. 68.
Mar. & c. 1726.

III. 1. A tabular account, shewing the strength and gradual increase and decrease of the tides of flood and ebb in the river Thames, as observed in Lambeth-reach, off of Manchester-stairs, and in the middle of the river, with a new instrument called the Marine Surveyor, on the 9th of June, 1720; it being then full moon, and consequently a spring tide. The movement of the machine 14 inches under water.

F L O O D.											
The Time of Flood.		The depth of the river.		The run of the current in every 15 min.	The whole run of the current to the times expres'd in the first column.	The same reduced to statute miles of 5280 feet, or 528 revolutions of the machine.		The reduction into English maritime miles of 6000 feet, or 600 revolutions.			
H.	M.	Feet.	In.	Feet.	Feet.	M.	Pts.	Rev.	M.	Pts.	Rev.
	15	5		110	110			11			11
	30	6		590	700			70			70
	45	6	9	1100	1800		$\frac{1}{4}$	48		$\frac{1}{4}$	30
I		7		1490	3290		$\frac{1}{2}$	55		$\frac{1}{2}$	29
I	15	8		1870	5160		$\frac{1}{4}$	120		$\frac{1}{4}$	66
	30	9		2230	7390	I	$\frac{1}{4}$	79	I		139
	45	10		2500	9890	I	$\frac{1}{4}$	65	I	$\frac{1}{2}$	89
2		11	6	2660	12550	2	$\frac{1}{4}$	67	2		55
2	15	13		2730	15280	2	$\frac{1}{4}$	76	2	$\frac{1}{2}$	28
	30	14		2740	18020	3	$\frac{1}{4}$	86	3		2
	45	14	9	2720	20740	3	$\frac{1}{4}$	94	3	$\frac{1}{4}$	124
3		14	9	2570	23310	4	$\frac{1}{4}$	87	3	$\frac{1}{4}$	81
3	15	14	10	2220	25530	4	$\frac{1}{4}$	45	4	$\frac{1}{4}$	3
	30	14	9	1820	27350	5		66	4	$\frac{1}{2}$	35
	45	14		.990	28340	5	$\frac{1}{4}$	62	4	$\frac{1}{2}$	134
	50	13	9	.130	28470	5	$\frac{1}{4}$	75	4	$\frac{1}{2}$	147

EBB.

Of the tides in the river Thames.

115

E B B.									
The time of ebb.		The depth of the river.		The run of the current in every 15 min.	The whole run of the current to the times expressed in the first column.	The same reduced to statute miles of 5280 feet, or 528 revolutions of the machine.		The reduction into English maritime miles of 6000 feet, or 600 revolutions.	
H.	M.	Ft.	In.	Feet.	Feet.	M.	Pts. Rev.	M.	Pts. Rev.
	15	12	9	280	280		28		28
	30	12	3	1140	1420	$\frac{1}{4}$	10		142
	45	11	10	1900	3320	$\frac{1}{2}$	68	$\frac{1}{2}$	32
1		11	4	2080	5400	1	12	$\frac{1}{4}$	90
1	15	11	2	2120	7520	1	$\frac{1}{4}$ 92	1	$\frac{1}{4}$ 2
	30	10	9	2120	9640	1	$\frac{1}{4}$ 40	1	$\frac{1}{2}$ 64
	45	10	4	2170	11810	2	125	1	$\frac{1}{4}$ 131
2		10		2130	13940	2	$\frac{1}{2}$ 74	2	$\frac{1}{4}$ 44
2	15	9	6	2060	16000	3	16	2	$\frac{1}{2}$ 100
	30	9	4	2040	18040	3	$\frac{1}{4}$ 88	3	$\frac{1}{2}$ 4
	45	9		2020	20060	3	$\frac{1}{4}$ 26	3	$\frac{1}{2}$ 56
3		8	9	1910	21970	4	85	3	$\frac{1}{2}$ 97
3	15	8	6	1900	23870	4	$\frac{1}{2}$ 11	3	$\frac{1}{4}$ 137
	30	8	3	1910	25780	4	$\frac{1}{4}$ 70	4	$\frac{1}{4}$ 28
	45	8		1860	27640	5	124	4	$\frac{1}{2}$ 64
4		7	9	1810	29450	5	$\frac{1}{2}$ 41	4	$\frac{1}{4}$ 95
4	15	7	3	1780	31230	5	$\frac{1}{4}$ 87	5	$\frac{1}{2}$ 123
	30	7		1690	32920	6	124	5	$\frac{1}{4}$ 142
	45	6	6	1620	34540	6	$\frac{1}{2}$ 22	5	$\frac{1}{4}$ 4
5		6	3	1570	36110	6	$\frac{1}{4}$ 47	6	$\frac{1}{2}$ 11
5	15	6	3	1570	37680	7	72	6	$\frac{1}{4}$ 18
	30	6		1570	39250	7	$\frac{1}{4}$ 97	6	$\frac{1}{2}$ 25
	45	6		1560	40810	7	$\frac{1}{2}$ 121	6	$\frac{1}{4}$ 31
6		5	9	1550	42360	8	12	7	$\frac{1}{2}$ 36
6	15	5	6	1500	43860	8	$\frac{1}{4}$ 30	7	$\frac{1}{4}$ 36
	30	5	3	1460	45320	8	$\frac{1}{2}$ 44	7	$\frac{1}{2}$ 32
	45	5		1450	46770	8	$\frac{1}{4}$ 57	7	$\frac{1}{4}$ 27
7		4	9	1430	48200	9	68	8	$\frac{1}{2}$ 20
7	15	4	6	1400	49600	9	$\frac{1}{4}$ 76	8	$\frac{1}{4}$ 10
	30	4	3	1380	50980	9	$\frac{1}{2}$ 82	8	$\frac{1}{4}$ 148
	45	4	3	1340	52320	9	$\frac{1}{4}$ 84	8	$\frac{1}{2}$ 232
8		4		1270	53590	10	79	8	$\frac{1}{4}$ 109
8	5	3	10	420	54010	10	121	9	$\frac{1}{2}$ 1
	10	3	11	410	54420	10	$\frac{1}{4}$ 30	9	$\frac{1}{4}$ 42
	15	4		400	54820	10	$\frac{1}{4}$ 70	9	$\frac{1}{2}$ 82
	20	4		380	55200	10	$\frac{1}{4}$ 108	9	$\frac{1}{4}$ 120
	25	4	2	300	55500	10	$\frac{1}{2}$ 6	9	$\frac{1}{4}$
	30	4	2	270	55770	10	$\frac{1}{2}$ 33	9	$\frac{1}{4}$ 27
	35	4	3	130	55900	10	$\frac{1}{2}$ 46	9	$\frac{1}{4}$ 40
	40			Stagnant.	Stagnant.				

Continued.
By the same.
lb. p. 71.

III. 2. A tabular account, shewing the strength and gradual increase of the tides of flood and ebb in the river Thames, as observed in Lambeth-reach, off of Manchester-stairs, and in the middle of the river, with a new instrument called the Marine Surveyor, on the 18th of June 1720; it being then the last quarter of the moon and consequently a neap tide. The movement of the machine 14 inches under water.

F L O O D.									
The time of flood.		The depth of the river.		The run of the current in every 15 min.	The whole run of the current to the times expressed in the first column.	The same reduced to statute miles of 5280 feet, or 528 revolutions of the machine.		The reduction into English maritime miles of 6000 feet, or 600 revolutions.	
H.	M.	Ft.	In.	Feet.	Feet.	M.	Pts. Rev.	M.	Pts. Rev.
	15	4		220	220		22		22
	30	4	3	520	740		74		74
	45	4	9	900	1640	$\frac{1}{4}$	32	$\frac{1}{4}$	14
I		5	3	1030	2670	$\frac{1}{2}$	3	$\frac{1}{4}$	117
I	15	5	9	1020	3690	$\frac{1}{2}$	105	$\frac{1}{2}$	69
	30	6	1	1160	4850	$\frac{1}{4}$	89	$\frac{1}{4}$	35
	45	7		1450	6300	I	102	I	30
2		7	9	1640	7940	I	$\frac{1}{2}$	I	44
2	15	8	1	1830	9770	I	$\frac{1}{4}$	I	$\frac{1}{2}$
	30	9		1920	11690	2	113	I	$\frac{1}{4}$
	45	9	6	2070	13760	2	$\frac{1}{2}$	2	$\frac{1}{4}$
3		10		2170	15930	3	9	2	$\frac{1}{2}$
3	15	10	4	2070	18000	3	$\frac{1}{4}$	3	$\frac{1}{4}$
	30	11	3	1960	19960	3	$\frac{1}{4}$	3	$\frac{1}{4}$
	45	11	4	1890	21850	4	73	3	$\frac{1}{2}$
4		11	9	1700	23550	4	$\frac{1}{4}$	3	$\frac{1}{4}$
4	15	11	6	1300	24850	4	$\frac{1}{2}$	4	$\frac{1}{2}$
	30	11		730	25580	4	$\frac{1}{4}$	4	$\frac{1}{4}$
	35	11		70	25650	4	$\frac{1}{4}$	4	$\frac{1}{4}$
	40			Stagnant.	Stagnant.				
	45	10	10	dit.	dit.				
	50	10	9	dit.	dit.				

E B B.

Of the tides in the river Thames.

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E B B.									
The time of ebb.		The depth of the river.		The run of the current in every 15 min.	The whole run of the current to the times expressed in the first column.	The same reduced to statute miles of 5280 feet, or 528 revolutions of the machine.	The reduction into English maritime miles of 6000 feet, or 600 revolutions.		
H.	M.	Ft.	In.	Feet.	Feet.	M. Pts. Rev.	M.	Pts.	Rev.
	15	10	6	610	610	61			61
	30	10		1340	1950	$\frac{1}{2}$ 63	$\frac{1}{2}$		45
	45	9	9	1520	3470	$\frac{1}{2}$ 83	$\frac{1}{2}$		47
1		9	3	1650	5120	$\frac{1}{2}$ 116	$\frac{1}{2}$		62
1	15	9		1750	6870	1 $\frac{1}{2}$ 27	1		87
	30	8	6	1730	8600	1 $\frac{1}{2}$ 68	1	$\frac{1}{2}$	110
	45	8		1700	10300	1 $\frac{1}{2}$ 106	1	$\frac{1}{2}$	130
2		7	9	1710	12010	2 $\frac{1}{2}$ 13	2		1
2	15	7	3	1710	13720	2 $\frac{1}{2}$ 52	2	$\frac{1}{2}$	22
	30	7	1	1710	15430	2 $\frac{1}{2}$ 91	2	$\frac{1}{2}$	45
	45	6	9	1710	17140	3 $\frac{1}{2}$ 130	2	$\frac{1}{2}$	64
3		6	7	1680	18820	3 $\frac{1}{2}$ 34	3		82
3	15	6	4	1670	20490	3 $\frac{1}{2}$ 69	3	$\frac{1}{2}$	99
	30	6		1570	22060	4 $\frac{1}{2}$ 94	3	$\frac{1}{2}$	106
	45	5	9	1500	23560	4 $\frac{1}{2}$ 112	3	$\frac{1}{2}$	106
4		5	8	1480	25040	4 $\frac{1}{2}$ 128	4		104
4	15	5	3	1440	26480	5 $\frac{1}{2}$ 8	4	$\frac{1}{2}$	98
	30	5	2	1430	27910	5 $\frac{1}{2}$ 19	4	$\frac{1}{2}$	91
	45	5		1420	29330	5 $\frac{1}{2}$ 29	4	$\frac{1}{2}$	83
5		5		1430	30760	5 $\frac{1}{2}$ 40	5		76
5	15	4	10	1420	32180	6 $\frac{1}{2}$ 50	5	$\frac{1}{2}$	68
	30	4	6	1430	33610	6 $\frac{1}{2}$ 61	5	$\frac{1}{2}$	61
	45	4	4	1420	35030	6 $\frac{1}{2}$ 71	5	$\frac{1}{2}$	53
6		4	1	1380	35410	6 $\frac{1}{2}$ 77	6		41
6	15	3	11	1360	37770	7 $\frac{1}{2}$ 81	6	$\frac{1}{2}$	27
	30	3	11	1340	39110	7 $\frac{1}{2}$ 83	6	$\frac{1}{2}$	11
	45	3	10	1230	40340	7 $\frac{1}{2}$ 74	6	$\frac{1}{2}$	134
7		3	10	1070	41410	7 $\frac{1}{2}$ 49	6	$\frac{1}{2}$	91
7	15	3	11	530	41940	7 $\frac{1}{2}$ 102	6	$\frac{1}{2}$	144
	20	4		20	41960	7 $\frac{1}{2}$ 104	6	$\frac{1}{2}$	146
	25			Stagnant.	Stagnant.				
	35	4	3	dit.					

3: March

An extraordinary high tide in the river Thames. By Capt. Tho. Jones. ibid. p. 68. The falls of the river Niagara in Canada. Taken from Mr. Borassau. By Paul Dudley, Esq; n. 371. p. 69. April, &c. 1732.

III. 3. March 8, 172 $\frac{1}{2}$, the tide in the river Thames, at New Crane in Shadwell, flowed 20 foot 5 inches and a half, taken by a level from that high-water mark to low-water the next morning; which was four inches higher than has been known these forty years.

IV. The falls of Niagara are a mighty ledge or precipice of solid rock, that lies a-cross the whole breadth of the river, a little before it empties itself into or forms the lake Ontario, and very steep. Monsieur Borassau never measured the falls himself, though he has been there at seven different times: but what he says is, That

This last spring the governour of Canada ordered his own son with three other officers to survey Niagara and take the exact height of the cataract, which they accordingly did with a stone of half a hundred weight and a large cod-line, and found it upon a perpendicular no more than 26 fathom; vintg & six bras. This differs very much from the account father Hennepin has given the world of that cataract, for he makes it 100 fathom; and our modern maps from him, as I suppose, mark it at 600 foot; but I believe Hennepin never measured it, and there is no guessing at such things.

When I objected Hennepin's account of those falls, M. Borassau replied, that every body had depended upon it as right until the late survey. Upon further discourse he acknowledged, that below the cataract for a great way there were numbers of small ledges or stairs cross the river, that lowered it still more and more 'till you come to a level; so that if all the descents be put together, he does not know but the difference of the water above the falls and the level below may come up to father Hennepin, but the strict and proper cataract upon a perpendicular is no more than 26 fathom, or 156 foot, which yet is a prodigious thing and what the world I suppose cannot parallel, considering the greatness of the river; for it is near a quarter of an English mile broad and very deep water.

Several other things Monsieur Borassau set me right in, as to the falls of Niagara: particularly, it has been said, that the cataract makes such a prodigious noise that people cannot hear one another speak at some miles distance, whereas he affirms you may converse together close by it.

I have also heard it positively asserted, that the shoot of the river when it comes to the precipice was with such a mighty force, that men and horse might march under the body of the river without being wet; this also he utterly denies, and says the water falls in a manner right down.

He observed farther to me, that the mist or shower (*la brume*) which the falls make, is so extraordinary as to be seen at five leagues distance, and rises as high as the common clouds. In this brume or cloud when the sun shines you have always a glorious rainbow.

The

Of the opening an ancient Well.

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The river it self, which is there called Niagara, he tells me is much narrower at the falls than either above or below, and that from below there is no coming nearer the falls by water than about six English miles, the torrent is so rapid and withal such terrible whirl-pools.

I my self this last summer, saw a cataract, three leagues above Albany, in the province of New-York, upon Schenectada river called the Cohoes, which they count much of there; and yet that is not above 40 or 50 foot perpendicular. From these falls also there rises a misty cloud, which descends like small rain, and when the sun shines, gives a handsome small rainbow that moves as you move, according to the angle of vision. The river at the Cohoes is to 40 or 50 rods broad, but then it is very shallow water, for I was told that in a dry time the whole river runs in a channel of not more than 15 foot wide.

V. In my journey to Albany, 20 miles to the eastward of Hudson's river, near the middle of a long rising hill, I met with a brisk noisy brook sufficient to serve a water-mill, and having observed nothing of it at the beginning of the hill, I turned about and followed the course of the brook, 'till at length I found it come to an end, being absorbed and sinking into the ground, either passing through subterraneous passages or soaked up with the sand; and though it be common in other parts of the world for brooks and even rivers thus to be lost; yet this is the first of the sort that I have heard of or met with in this country.

Abrook absorbed in America. By the same. ibid. p. 72.

VI. Tuesday, Sept. 24, 1723, we met at the well near Queenborough where the castle formerly stood, and finding but very little water at the bottom on our sounding, and a new curb having lately been fixed on the top, we provided our selves with buckets and ropes, and lowered down a man, who acquainted us, that it was cleaned, and the ground sunk four foot deeper than the curb at the bottom. We then measured the depth of it, and found it 200 foot, and artificially steened the whole depth with circular Portland stone, which is all entire, and stands fair, the mean diameter being four foot eight inches; but observing, that not one drop of water came into it, we resolved to try whether we could find any by boring. In order thereunto, we got a piece of timber about seven foot long, and boring it through with a three inch and a half auger, fixed the trunk at the bottom of the well, fastening it by quarters to the curb at the bottom, to prevent its rising, and filled it all round three foot deep with clay, and on that laid four course of bricks for a platform for the men to stand on in their boring, and got also an auger of two inches and an half, to bore through the clay, but could not get all our necessities ready 'till Thursday the 26th of Sept. when three men at a time began to bore, shifting every three hours. The boring which they sent us up, was a very close bluish clay, which continuing the same after three days and a half working we began to despair of meeting with water; but on Monday the 30th of Sept. in the evening, the auger slipt down at

An account of the opening an ancient well near Queenborough in Kent. By the King's officers at Sheerness and Chatham. Communicated by Mr. P. Collison. n. 411. p. 191. Oct. &c. 1729.

once,

once, and up came water, to our great satisfaction; and in an hour's time there was upward of four foot water; it rose so fast, that at twelve o'clock at noon,

	Feet.	Inch.
On the 1st of October we found	55	10
On the 2d, at 5 in the afternoon	109	08
On the 3d, at 3 in the afternoon	132	06
On the 4th, at 3 in the afternoon	149	06
On the 5th, at 4 in the afternoon	161	03
On the 6th, at 10 $\frac{1}{2}$ in the morning	167	08
On the 7th, at 4 in the afternoon	174	00
On the 8th, at 7 in the morning	176	07

and it still encreases though slowly. Its not rising so fast now as at first, we apprehend proceeds from the weight of water which the spring through the hole of the trunk must force up, and from the well's being wider aloft than below. What we think very extraordinary is, that we bored 81 foot below the foot of the trunk before we met with this body of water, which by computation is 166 foot below the deepest place in the adjacent seas. The water proves exceeding good, soft, sweet, and fine; we compared it with the best spring water brought from Milton, and in every bodies opinion the well-water is the best. We put some soap to it, and it lathered finely; we boiled old pease in it, which succeeded very well, and we have great reason to believe, that the spring will sufficiently supply his Majesty's ships, as proposed.

The nature and virtues of Holt-waters. By Mr. J. Lewis. n. 408. p. 43. March, &c. 1729.

VII. Experience has proved these waters of admirable efficacy in many disorders, especially in scorbutic and scrophulous cases. The allom and iron with which they are impregnated give them a notable degree of astringency, whereby they brace the solids, stimulate the fibres, and quicken their contractile power. To sulphur and ochre they owe their drying, absorbing, and healing quality, whereby they imbibe the peccant humours, and sheath the sharp salts that lance and tear the finer glands, causing blotches and ulcerations. They are also a noble diuretic.

The rise of some of the most considerable rivers in Europe. By Dr. J. G. Scheuchzer. n. 406. p. 586. Dec. 1728.

VIII. The mountains called the Avicula, the Luck-mannier Berg, the S. Gothard, the Furca, the Grimsula, the Crispalt, the Sempronier or Sempronius Mons, the Adula, and a chain of others, are the Lepontia Alpes of Pliny* and the Summæ Alpes of Cæsar. † They begin in the upper Valesia, traverse the canton of Uri, and run eastwards across the country of the Grisons towards Tirol. Their greatest height above the level of the sea, may be fixed in round numbers to 7500, or 8000 Paris feet. From these mountains some of the most considerable rivers of Europe take their first rise, within very small distances of each other. The Rhosne, for instance, Rhodanus, by Marcellinus called maximi nominis flumen, and by Varro fluvius inter tres

* Lib. iii. c. xx. † De Bell. Gall. l. iii.

Europæ maximus, arises from two Gletchers, as we call them, or Montes glaciales, huge mountains of ice, near the Furca, and thence runs with great impetuosity down Valesia, the Wallisserland, forming a long valley surrounded on both sides with huge mountains, 'till it loses its waters and name in the Lacus Lemanus, or lake of Geneva, but resumes it again near the town of Geneva, whence it flows with a more gentle descent through some provinces of France into the mediterranean sea.

The Thesin, Ticinus, by Claudian in his panegyric upon the consulate of the Emperor Honorius, called pulcher, takes its first rise from two small lakes upon the S. Gothard, and some lateral sources from the lago sopra la cima di Pettine, upon a mountain called Pettine, the lago della sella, the lake of Rottom upon the Luckmannier Berg, the lake of Tom, and the lake of Bedretto upon a mountain of the same name. It descends the Lavinia Vallis, or Liviner Valley, and in its way to the lake of Locarno receives many brooks and rivulets from the adjoining mountains: it unites its waters with the Po near Pavia, and loses itself jointly with that river in the Adriatic gulf.

The Rhine, Rhenus, by Cæsar de B. G. termed latissimus atque altissimus, arises in three several branches which are called Rhenus anterior, posterior, & medius, the further, the hinder, and middle Rhine. The last of these takes its rise upon the high mountain Avicula, Colmen del Ocello, part of the Adula, in the Alp San Porta, from a Gletcher or ice-mountain which extends in length full two hours. The middle Rhine, Rhenus medius arises upon the Luckmannier Berg, which is likewise part of the Adula, in the upper part of a valley called San Maria, opposite to one of the sources of the Thesin. The further Rhine, Rhenus anterior arises upon that branch of the Crispalt which is called Cima del Badut, Badüz, and soon receives several lateral branches from the Alps Mugels and Cornera. Near the monastery of Disentis the further and middle Rhine join together, and the united stream falls into the hinder Rhine, near Reichenau. Below Rheineck the Rhine falls into the Lacus Bodamicus, or Boden sea, and comes out of it near Stein; whence washing for sometime the borders of Swisserland, it then traverses great part of Germany in a very irregular course, 'till at last in Holland it loses itself in the great ocean.

The Reüs, Rusa, arises from a small lake called lago di Luzendro upon the S. Gothard, but soon receives a considerable inforcement from the Furca, and near Urselen another from a mountainous lake in Oberalp. Near Fluelen not far from Ury it enters the IV. Waldstetten sea, lacus quatuor civitatum sylvestrium, but resumes its course and name at Lucern, and at last falls into the Aar below Windisch, Vindonissa.

The Aar, Arola, Arula, arises upon the high mountain Grimsula in the upper Valesia. About three hours below that it falls into the lake of Brientz, and out of that, not far from the monastery

Intelrachen, into the lake of Thun, and thence running by Bern, Solothurn and so down, falls at last after many windings and turnings into the Rhine near Coblentz, Confluentia, probably so called from the uniting of these two considerable rivers.

Of the lakes in Swisserland. By the same, ib. p. 592.

IX. There are several very remarkable lakes in Swisserland, and upon its borders. The ascent of the mountains in that country is so very sudden and quick that their elevation in the canton of Glarus above the horizon of Zurich, though not quite three days distant, is more than three times as great as the elevation of Zurich itself above the level of the ocean, from which it is upwards of 375 English miles distant in a streight line; and so in proportion of others. The rivers which rise in these mountains rushing down, in consequence of so quick a descent, with great force and impetuosity, would often overflow their banks and cause frequent inundations in the flat countries (of which there are too many instances in our own vallies and plains) if this force and impetuosity was not in great measure broke and their waters disposed to a more gentle descent. This is effectually done by those great receptacles of water, the lakes; which are besides of infinite use to the inhabitants around them, supplying them with plenty of fish for their sustenance, and enriching them by the facility with which commerce is carried on over them. Thus the Rhine falls into the Lacus Bodamicus, Boden-Sea, the Rhofne into the Lacus Lemanus or lake of Geneva, the Muesä and Thefin into the lake of Locarno, the Reüfs into the lake of Lucern, the Adda and Maira into the lake of Como, the Lint or Limat into the lake of Zurich, the Aar into the lakes of Brientz and Thun. And the more considerable the rivers are and the more impetuous their course, so much the greater are the receptacles wherein they are to lose their force and rapidity. The Lake of Geneva and the Boden-Sea, the two largest in Swisserland, evidently evince what I here assert, and the others above-named gradually decrease in largeness in proportion as the rivers which fall into them are less and less rapid.

C H A P. III.

Mineralogy.

Observations towards a natural history of mines and metals. By Dr. Fr. Nicholls. n. 401. p. 402. Jan. &c. 1728.

I. 1. **M**INES in general are veins or cavities within the earth, whose sides receding from, or approaching nearer to each other, make them of unequal breadths in different places; sometimes forming large spaces, which are called holes. They are filled with substances, which, whether metallic, or of any other nature, are termed the loads. When the

the substances forming these loads are reducible to metal, the loads are by the miners said to be alive ; otherwise they are termed dead loads.

In Cornwall and Devon the loads always hold their course from E. to W. though in other parts of England they frequently run from N. to S. The miners report that the sides of the load never bear in a perpendicular, but constantly underlay either to the N. or S.

The mines seem to be, or to have been, the channels through which the waters pass within the earth ; and like rivers have their small branches opening into them in all directions ; which are by the miners termed the Feeders of the load.

Most mines have streams of water running through them, and when they are found dry it seems to be owing to the waters having changed their course, either because the load had stopped up the ancient passages, or that some new and more easy ones are made.

The load is frequently intercepted by the crossing of a vein of earth, or stone, or some different metallic substance. In which case it generally happens that one part of the load is moved a considerable distance to one side. This transient load is by the miners termed a Flooding ; and the part of the load which is moved is in their terms said to be heaved. This heaving the load would be an inexpressible loss to the miner, did not experience teach him that as the loads always run on the sides of the hills, so the part heaved is always moved towards the descent of the hill. So that the miner working towards the ascent of the hill, and meeting a Flooding, considers himself as working in the part heaved ; wherefore cutting through the Flooding, he works upon its back towards the ascent of the hill 'till he recovers the load, and vice versâ.

Thus A D shews a load running in the side of a hill, B the feeders, Fig. 31. C the flooding, D is the part heaved.

Sometimes, though not constantly, the mine is lined with an intermediate substance between the load and it self. This is (properly speaking) the wall of the load : though in the common acceptation of that term it signifies either such intermediate substance, or the side of the mine where the load immediately unites itself to it. Thus A Fig. 32. is the side of the mine, B the intermediate wall of white mundic, C the load of copper. And A B the two walls of spar-stone, C a small vein Fig. 33. of tin ore.

The springs in these parts are always hard, as abounding very much either in stony or sulphureous saline particles. From this water thus saturated with stony particles, we frequently find the passages of the water under ground, either partly, or totally stopped up ; the stony matter gradually concreting round the sides of the mine, and forming thereby a confused load of spar-stone. At other times this stony matter concretes more distinctly : in which case the stony matter seems to be

governed in its concretion by a plastic power; by which I would be understood to mean only a *modus* of attraction, whereby the attracted particles are ranged in this or that determined form. This power then so exerts its action as to range the concreting matter into the form of an hexagonal prism, whose head goes off in an hexagonal pyramid. Where this plastic power happens to be single and uncontrouled, it preserves the form of the crystal to very considerable magnitudes.

In these single crystals we may observe that they are of different transparencies and colours, as the stony matter is more or less disengaged from other substances, or as those other substances are capable of imparting different tinctures to them. And that they seem formed laminatim; though the laminæ are only distinguishable when the matter from whence the crystal is successively formed happens to differ in purity. Thus the crystal A was at first formed from matter intangled with a foul yellow substance; after which a pure matter advening, the crystal was in its future lamination formed more transparent.

Fig. 34.

But where the plastic particles are more numerous, there seems reason to believe that these very plastic particles, before they are fixed, are subject to the controul and direction of any fixed plastic particle within the verge of whose activity they happen to move: notwithstanding which, after they are once fixed, they exert their own plastic powers, and in conjunction with the first plastic particle govern the future concretion, in such manner as to form a seemingly irregular crystal, though composed of two or more regular crystals. Thus in fig. 35, and 36, A and C seem to have attracted amongst the stony particles two plastic ones, which afterwards exerting their own powers formed the additional crystals B and D.

Fig. 35. 36.

There are many phænomena observable in these crystals, which at present I pass over as less relating to the affair of metals; wherefore I shall only add, that these crystalline concretions exert a strong attraction on many metallic substances. As in Fig. 37, A the spar has attracted the three portions of lead B, and in Fig. 38, the crystals C have attracted the copper D, and are attracted by the lead E.

Fig. 37.

Fig. 38.

The sulphureo-saline particles, with which, as I observed, the waters are frequently saturated, are found to be either of a vitriolic or an arsenical nature: the first constantly, if pure, concreting into white cubes resembling grains of silver, while the arsenical sulphur concretes into yellow cubes like grains of pure gold. Both these are by the miners termed mundic.

These sulphureo-saline substances seem directed in their concretions by a plastic particle, in the same manner as the crystals above-mentioned; and, like them, upon the same principles, are found simple or compound. In their sides you may observe the concretion forms itself like threads, which in three sides run in different directions, but are always similar in the opposite sides.

Fig.

Fig. 39. shews one of these cubes, A the parallel threads.

Fig. 39.

Fig. 40. shews another of these cubes, from whose sides arise small segments of cubes C.

Fig. 40.

But this plastic power seems to be weakened or destroyed, in proportion as this sulphureous matter is more or less intangled with metallic substances.

Thus in Fig. 41. the plastic particle seems for a while to have exerted its power in the usual manner, 'till the advening matter grew intangled with a small quantity of copper, after which it seems only to have exerted its attractive but not its plastic power.

Fig. 41.

And in Fig. 42. the white mundic being infected with iron, seems so far from being affected by a plastic power, that it concreted in the form of icicles from the fluid which transfused through the top of the mine.

Fig. 42.

Fig. 43. represents some small cubes of white or vitriolic mundic.

Fig. 43.

But to return to the mines: those in Cornwall are found to contain iron, tin, lead, copper, and a pseudometallic substance by the miners termed Glift.

I. 2. Of all the substances concurring to form the terrestrial globe iron probably bears the greatest share; as it not only abounds in most kinds of stone, shewing it self in varieties of crocus, all which gain a more intense colour by fire; but enters likewise greatly into the composition of common clay, as may be judged from the similitude of colour between clay and dry iron oar; from the easy vitrification of clay; from the resemblance between clay so vitrified and the clinkers of iron; from its deep red colour after calcination; and lastly, from its yielding pure iron, by being burned with oil.

*Continued by the same.
n. 403. p. 480.
July, &c.
1728.*

But while iron is thus entangled with other bodies it rarely employs the care of the miner; who finds the expence of reducing it to metal too seldom balanced by the price it yields. For which reason, though we frequently meet with large and rich loads of iron, yet the woods having been applied to more advantageous uses, they are there entirely neglected.

When it is most pure I find the oar under three different appearances.

The first is a rich dry oar, whose scrapings exactly resemble an alkohol martis. This kind of iron oar has very nearly the colour of common clay.

The second is a rich iron oar, the wall of the load being formed by a concretion of yellow crystals. In this stone the iron radiates from points forming segments of spheres, and where these spheres leave any interstices you will find a crocus, or oker.

The third is a stone of iron of the kind used for burnishing plate; it is of the species of the Hæmatites. Both these last stones scrape into a deep crocus.

From

From the second instance we may conjecture, that the yellow colour in crystals arises from a crocus entangled with the stony salts.

Though the want of wood in Cornwall deprives it of the advantages it might otherwise reap from iron as a metal, we shall nevertheless find it far from being an useless oar, when we consider it as sometimes impregnating the waters with vitriolic salts, thereby making them a proper menstruum for dissolving the disseminated particles of metals; sometimes destroying the sulphureous menstrea, which (though they dissolve the disseminated metals) do nevertheless obstruct their new concretions; and sometimes as being it self the magnet by which the metallic particles are attracted into new concretions.

The next metallic substance found in Cornwall, and from which these islands are supposed to take their name, is tin. It is never found but as an oar; whereas gold is never found but as a metal, at least its oar is unknown, and all other metals are found sometimes as a metal, and sometimes as an oar.

Tin always shoots into crystals which are of different magnitudes from two ounces in a single crystal to such as escape our sight. These crystals are for the most part interspersed in loads of other substances.

Sometimes we find them in a load of a kind of clay, in which is observable a considerable quantity of red-oker.

Sometimes in hard iron-stones we find exceeding small crystals of tin.

Others somewhat larger we meet with in a dry red-oker,

And sometimes interspersed with spar-stone and a sort of marle.

When a hundred sacks of the load (each containing more than a Winchester bushel) yield one gallon of clean oar, the load is esteemed very well worth working.

Sometimes these crystals are so collected into one mass, as to form loads of pure tin oar, and so large as to yield to the value of 100l. every twenty-four hours.

These crystals concrete sometimes into the form of a parallelopipedon, whose summit is covered by a pyramid; sometimes the angles formed by the sides of the pyramid, and sometimes the summit of the pyramid are as it were plained away.

Sometimes the crystals represent two equal pentelateral pyramids joined at their base.

Under whatsoever form these crystals shoot, they always carry an exceeding fine surface; which, when rubbed off, can be renewed by no art.

They are of different colours, from the white (like white sugar candy'd) to the deep black. I have some small white crystals which seem to me to carry a finer lustre than any other I ever saw, and are perfectly transparent; so that were they found of equal size with the black

black crystals, and of a white water (which I imagine may be) their weight (in which they exceed any other fossil) would probably give them a lustre not inferior to the diamond. However, as the deeper colours of these crystals seems to arise from a greater proportion of iron in their composition, which they partly throw off in an iron slag upon fusion, and which changes by proper degrees of heat into a crocus, thereby changing the colour of the crystal to a brighter red; so the white tin ore is certainly to be esteemed both richest and best, as most free from iron.

These crystals seem to be the heaviest bodies the earth produces, except quicksilver and actual metals. Their specific gravity is to water as $90\frac{1}{2}$ to 10; to rock crystal in water as $90\frac{1}{2}$ to 26; to diamond as $90\frac{1}{2}$ to 34; and to pure malleable tin, as found by repeated trials, as $90\frac{1}{2}$ to 78; from whence appears the possibility of what some miners affirm, viz. that a cubical inch of some tin ores, will yield more than a cubical inch of metal.

Having already taken notice that the crystals of tin are sometimes so small as to escape the eye, and so disseminated in the load as not to make above $\frac{8}{1000}$ th, or $\frac{1}{1000}$ part of the load, one would naturally imagine it an endless labour to cleanse the ore from such a vast disproportion of rubbish. But the great specific gravity of these crystals renders the cleaning it less troublesome, and less expensive than in any other ore whatever. It requires no more than that the whole stuff be stamped to a fine powder, after which it is washed by a water, whose force is so moderated as to wash away only the lightest parts. This stamping and washing is repeated 'till the ore is left exceedingly clean, and yields in metal from $\frac{1}{10}$ to $\frac{1}{20}$ th, according as it is cleansed from the load, and as it is in its own nature more or less free from iron.

Specimens of all the several ores and crystals above described are lodged in the curious repository of Sir Hans Sloane, Bart.

II. 1. The lead mines in Derbyshire are very various with regard to their courses. One into which I went down had two branches; one running to the N. E. the other to the N. W. And as I was informed, one of the best they ever discovered ran due N. Their breadth and depth are full as irregular. The bodies through which they dig to come at the vein are generally lime-stone and black-shale. But it is uncertain which of the two is uppermost. Of two mines into which I went down, in one they had dug first through 26 yards of lime-stone, then through one of black-shale: in the other, first through 42 yards of shale, and then through 28 of lime-stone. The substances which they find mixed with the ore are

1. Chert. This is a kind of flint which Dr. Woodward * says is called so when it is found in thin strata. But in the Peak the strata of chert are often four yards thick, or thicker. They are found in lime-

* Method of fossils, p. 21.

stone

Of the lead-mines in Derbyshire. By Mr. John Martyn. n. 407. p. 30. Jan. &c. 1729.

stone and not always disposed in strata. Those which I took notice of were generally either black, or of such a colour as the inspissated juice of the buckthorn-berries, which the painters call by the name of sap-green : whence they are called green cherts and black cherts.

2. Spar. This is composed of crystal mixed with other bodies. Those which they call sugar-spars are those whose crystallizations are very small, and so on crumbling to pieces have the appearance of powdered sugar. I have two sorts of these ; white and blue. Dog-tooth spar is a white pointed spar, in form and colour something resembling teeth.

3. Cauk. This Dr. Woodward * says is a coarse talky spar. But in that substance which I met with in this country under the name of cauk I could not discover any flexibility or elasticity, which that learned writer has set down as characteristics of talk and talky bodies †. It seems to me to be nothing but spar incorporated with a coarse earthy matter. When this cauk is mixed with pellucid crystallizations of spar, it is called bastard cauk.

There are several other bodies mixed in the mines with lead-ore : but as they did not occur in those mines which I examined I shall omit the mention of them.

When the ore is brought up from the mine it is broken to pieces that the spar, cauk, or other bodies which adhered to it may be the more easily separated. It is then thrown into a large sieve and washed, and so farther purified from extraneous bodies. After this it is carried to the furnace in order to be smelted. The furnace which I saw near Worksworth was very rude and simple, consisting only of some large rough stones placed in such a manner as to form a square cavity, into which the ore and coals are thrown stratum super stratum ; two great bellows continually blowing the fire, being moved alternately by water. I saw no other fuel used on this occasion but dried sticks, which they call white coal. || Mr. Ray informs us, that they use both white and black coal or charcoal in Cardiganshire. I suppose because that ore is harder to flux ; the charcoal making a more vehement fire. They generally throw in some spar along with the ore, which is thought by imbibing the sulphur to make it flux more easily. They frequently throw in also some cowke (or cinders of pit-coal) because they think it attracts the dross, and so makes an easier separation of it from the lead. When the ore is melted it runs out at an opening in the bottom part of the front of the furnace, through a small channel made for that purpose, into a cylindrical vessel, out of which it is laded into the mould. The dross of the ore on smelting is called slag. This slag is afterwards smelted again with cowke only,

* Method of fossils, p. 18. † Catalogue of fossils, Vol. I. Part I. p. 57.

|| Collection of English words, ed. 2. p. 174.

and the lead obtained from it is called slag-lead. Their way of making red-lead is the same with † Mr. Ray's account; only they use three parts of lead, and one of slag-lead; and think that the red-lead made thus is better than if made without slag-lead.

II. 2. In the Phil. Transf. n. 360 * I gave an account of the several strata of earths and minerals found in some of the coal-works in Somersetshire; but where I said that in those parts they never meet with free-stone over the coal, the printer by mistake has called it fire-stone; whereas fire-stone is always found in those mines, contrary to the works in Staffordshire, Newcastle, and Scotland, where free-stone does indeed lie over the coal. I have farther observed the strata of stone, clay, and marle of the interjacent hills, where under the black marle lies a spongy yellowish earth; all this lies above the red soil which generally makes the surface of the vallies where the coal is found. And as this red mould on the surface degenerates into marle or loom, so towards the N. W. beyond or without the veins of coal, about Winford in the same county, it turns to ruddle or red-ochre, used chiefly for marking of sheep, and for ground colours or priming instead of spanish brown; and often counterfeits bole armoniac.

But as I never heard any coal was found to the W. or S. of Mendip-hills; so Cotswold to the N. E. and the chalk-hills of Marlborough-downs and Salisbury-plains seem to set bounds to the coal country, to the E. and S. E. of which fig. 44. may be supposed a section from S. E. to N. W. viz. from the dip to the rise; and fig. 45. at right angles from S. W. to N. E. on the drift or level.

I mention this by way of correction and addition to my former observations of the coal-works in Somersetshire. I have since had opportunities to view several coal-works in Scotland and Northumberland. At Widdrington they have four fathom clay, then a seam of coal about 6 inches thick and not worth working; then a white free-stone; then an hard stone which they call a whin; then two fathom of clay; then a white soft stone; and under that a vein of coal three foot nine inches thick. This is a small coal of the same nature, but not so good as the Newcastle-coal which comes to London market. These veins dip to the S. E. one yard in twenty. Near Tranent in E. Lothian in Scotland the coal dips also to the S. E. in the same proportion; but at Baldoe in the parish of Campsy, three miles from Kylfith it dips to the N. E. and at Madestone near Falkirk to the same point and in the same proportion. The strata of earths and minerals at these places agree very near. They have, as the ground rises or falls, one, two, or three fathom of clay; then eleven fathom of slate or coal-clives; one fathom of lime-stone; under that two fathom of slate, earth, and stone; and then coal. And all these agree in this; that the pits generally need no timber, and have a good roof supported by

The strata in coal-mines, &c. By John Strachey Esq; n. 391. p. 395. Nov. &c. 1725.

* Vol. IV. P. II. C. III. § xvii.

Fig. 44.

Fig. 45.

† Edit. 2. p. 200.

pillars of coal which they leave in the working. At Baldoe the coal is commonly forty-five inches thick; and all along for some miles E. thence, on the sides of the hills, are crops of coal and lime-stone; the tenants often spit up as much just under the surface as will serve their turn for a winter's burning; but there wants a market and it is scarce worth working for sale. To the N. W. and N. in the drift of the coal in higher ground, and consequently lying over it, there appear in the sides of the hills seams of spar and lead, the drift of which is N. E. and lies almost perpendicular; but what obliquity there is pitches to the S. E. At Auchenclauch six miles east from Kylesith there is a coal eighteen foot thick; this dips one foot in three and is not pursued by reason of water; and for want of a market will not quit the cost of draining. At Madestone the coal is four foot and a half thick, above three fathom and a half deep. They land it (as at many coal-hews in the country) on girls backs. Near Tranent are three different veins wrought; the undermost is about eighteen fathom from the surface, called the plenty-coal, four foot and a half thick; it is a hard but not large coal; makes a clear and strong fire; lies ten fathom under the main coal, which is nine or ten foot thick, and comes out very large. Its roof is of free-stone, under which I walked backward and forward two hours; but had no opportunity to make any other observations on the upper vein, than that it is about four foot thick, and neither so hard nor so large as the other.

Fig. 46. 47.

As I have in fig. 44 and 45, drawn the different strata (which have come to my observation) on a supposed plane as they there lie; in fig. 46 and 47, I protract the same in a globular projection, supposing the mass of the terraqueous globe to consist of the foregoing, or perhaps of ten thousand other different minerals, all originally whilst in a soft and fluid state tending towards the center. It must mechanically and almost necessarily follow by the continual revolution of the crude mass from W. to E. like the winding up of a jack or rolling up the leaves of a paperbook, that every one of these strata, though they each reach the center, must in some place or other appear to the day; in which case there needs no specific gravitation to cause the lightest to be uppermost, &c. for every one in its turn, in some place of the globe or other, will be uppermost; and were it practicable to sink to the center of the earth, all the strata that are would be found in every part. Add to this that in all the places within my knowledge, Dr. Stukely's observation holds good, that the precipices of all hills are to the W. whereas the ascent to the E. is more gradual.

The strata found in digging the mineral wells at Holt. By Mr. -- Lewis. n. 403. p. 489. July, &c. 1728.

II. 3. AFTER they had passed the upper turf they came to a blue clay which held about three foot; then they met with a yellow, brittle clay, very much like ochre, used by painters, about two foot in thickness; and next with a loam of a looser texture, which sparkled with a kind of talk, called by the naturalists selenites, and was intermixed with yellow

yellow ochre. These selenites which were plentifully found in the clay were crystals consisting of transparent, shining, brittle flakes, some of a rhomboidal, others of a conical figure, but all hexaedra or columns of six sides. They had no sensible taste of salt, and the clay in which they were found was interspersed with veins of earth, of the colour of sulphur and iron rust.

Below this, at about 10 foot deep, they came to a bed of stones of a large size and very hard texture, coated with flakes of gypsum of a white and yellowish colour which run through and divided them as it were by various membranes into different cells, all filled with a hardened grey loam. These stones, which were all of an oval figure resembling pebbles, weighed from 10 to 60 pound, and lay all on a level one by another in the bed of clay. Here the springs come in, and below this the clay was darker coloured and interlaid with small shells of the oyster, escallop and muscle kind, and with a few belemnites curiously shaped. Here they met with stones of a very close texture, which when washed seemed to be nothing but a mass of shells jumbled and embodied together. And a little lower the clay produced some lumps of a black, bituminous sulphur, interlaid with some small thin laminæ, seeming to be metalline and bright like the purest silver. Upon firing this sulphurous bitumen on a red-hot iron it emitted a blue flame and strong smell like brimstone, but the metal was lost. From this account of the different strata found in sinking these wells, their impregnation seems to be from allum, vitriol of steel, ochre and sulphur, and from an accurate mixture of all these which no art can imitate it seems to derive those admirable qualities with which it is endued.

Some conjecture may be made of its nature and qualities from the tinctures it gives upon chymical experiments: with astringent drugs, as galls, oak-leaves and balaustines, it sometimes tinges red inclining to purple, and sometimes will not tinge at all; with volatile alkalies, as spirit of urine and sal armoniac it turns milky; with lixiviate salts, as oil of tartar per deliq. &c. it rises in a white curdle; but acid saline liquors, as spirit of salt, nitre, &c. cause no alteration.

A gallon and half of this water being evaporated *ad siccitatem*, the reliquæ weighed 3 drams, 1 scruple and 19 grains, some parts of which were white, and shot into striæ like needles, and others into prisms.

The neighbouring country is chiefly a strong clay; the quarries produce a very hard stone, which seems to be a composition of shells closely cemented and embodied together, and some marchasites which abound with sulphur. In sinking deep pits they throw up stones like iron-ore, covered with a shining metallic substance and serpentine stones, &c. and the ploughed fields abound with stones resembling shells of the escallop and cockle kind, striated with some astroites which are all strong alkalies, and with aqua-fortis or spirit of nitre raise a violent ebullition.

*Of the pits
for fuller's-
earth in Bed-
fordshire. By
Mr. B. Hol-
loway to Dr.
Woodward.
n. 379. p. 419.
Sep. & c. 1723.*

II. 4. FROM the surface for about six yards depth there are several layers of sands, all reddish, but some lighter coloured than others, under which there is a thin stratum of red sand-stone which they break through; and then for the depth of about seven or eight yards more you have sand again, and after that come to the fuller's-earth; the upper layer of which being about a foot deep they call the cledge; and this is by the diggers thrown aside as useless, because of its too great mixture with the neighbouring sand, which covers and has insinuated itself among it. After this they dig up earth for use to the depth of about eight foot more, the matter whereof is distinguished into several layers, there being commonly about a foot and a half between one horizontal fissure and another. Of these layers of fuller's-earth the upper half, where the earth breaks itself, is tinged red, as it seems by the running of water from the sandy strata above; and this part they call the crop; betwixt which and the cledge above-mentioned is a thin layer of matter not an inch in depth, in taste, colour and consistency not unlike to terra Japonica. The lower half of the layers of fuller's-earth they call the wall-earth; this is untinged with that red above-mentioned, and seems to be the more pure and fitter for fulling; and underneath all is a stratum of white rough stone of about two foot thick, which if they dig through, as they very seldom do, they again find sand and an end of their works.

One thing observable in the site of this earth is, that it seems to have every where a pretty equal horizontal level; because they say that when the sand-ridges at the surface are higher, the fuller's-earth lies proportionably deeper.

In these works they seldom undermine the ground, but as they dig away the earth below others are employed to carry off the surface; otherwise the matter above being of so light and flitting a nature would fall in and endanger the workmen. For that stratum of sand-stone which occurs before they come to the fuller's-earth does not lie, as in coal-pits, immediately over the matter they dig for, like a cieling, but in the very midst of the superjacent strata of sand; and therefore can be no security to them if they undermine.

The perpendicular fissures are frequent, and the earth in the strata, besides its apparent distinction into layers, like all other kinds of matter, by reason of its peculiar unctuousness, or the running of the adjacent sand imperceptibly among it, breaks itself into pieces of all angles and sizes.

For the geographical situation of these pits, they are digged in that ridge of sand-hills by Woburn which near Oxford is called Shotover, on which lies Newmarket-heath by Cambridge, and which extends itself from E. to W. every where, at about the distance of eight or ten miles from the hills called in Cambridgeshire Gog-magog, in Bucks and Oxon, the Chilton-hills, from the chalky matter of which

which they chiefly consist. These two ridges of hills you always pass in going from London into the N. N. E. or N. W. counties in the manner before mentioned : after which you come into that vast vale which makes the greater part of the midland counties of Cambridge, Bedford, Bucks, Northampton, Oxford, and Gloucester, and in which are the rivers Cam, Ouse, Nen, Avon, Isis and others. This I take notice of, because it confirms what you say of the regular disposition of the earth into like strata or layers of matter, commonly through vast tracts : from whence I make a question, whether fuller's-earth may not probably be found in other parts of the same ridge of sand-hills among other like matter.

II. 5. OUR marle is found only in the bottoms of low boggs, where we search for it with augres, and find it at the depth of seven, eight, or nine foot ; which in many places occasions great expence in draining off the water. When we think to dig for it we chuse out six able labourers and a supernumerary ; then we cut up a hole twelve foot square ; because we judge that this number of men will manage such a pit in one day, viz. two men to dig, two men to throw it up, and two men to throw it by. The supernumerary supplies defects in every part, as may be found necessary. For the first three foot we meet with a furzy sort of earth which we call moss, proper to make turf for fuel ; then we find a stratum of gravel about half a foot ; under which for about three foot more we find a more kindly moss, that would make a more excellent fuel. This is altogether mixed with timber, but so rotten that the spade cuts it as easily as it doth the earth. Under this for the depth of three inches we find leaves, for the most part oaken, that appear fair to the eye but will not bear a touch. This stratum we find sometimes interrupted with heaps of seed, that seems to be broom or furze-seed : nay, in one place I saw what appeared to me to be gooseberries and currants, in other places in the same stratum we find sea-weed and other things as odd to be at that depth. Under this appears a stratum of blue clay, half a foot thick, fully mixed with shells ; this we look upon to be good marle and throw it up as such. Then appears the right marle, commonly, two, three, or four foot deep, and in some places much deeper, which looks like buried lime, or the lime that tanners throw out of their lime-pits, only that it is full mixed with shells. These are small perriwinkles, such as the Scots call fresh water-wilks ; though there are among them abundance of round red perriwinkles, such as I have often seen thrown out on the sea-shore. Among this marle, and often at the bottom of it, we find very great horns which we, for want of another name, call elk-horns. Where they join the head they are thick and round ; and at that joining there grows out a branch of about a foot long that seems to have hung just over the beast's eyes. It grows round above this for about a foot and more ; then spreads

The strata found in digging for marle in Ireland. By Mr. Jam. Kelly. n. 394. p. 122. May &c. 1716.

Fig. 48.

*An account of
the Peak in
Derbyshire.
By Mr. John
Martyn.
n. 407. p. 22.
Jan. &c.
1729.*

broad and ends with branches long and round, turning with a small bend. The labourers are commonly so busy that they rarely bring them up whole; yet I have one pretty well, of which I send you the figure, drawn as well as I could, but not so well as I could wish. We have also found shanks and other bones of these beasts in the same place.

III. THE Peak is famous for seven places which have been dignified by our ancestors with the name of wonders: 1. Chatworth, a magnificent seat of the D. of Devonshire; 2. Mam-tor; 3. Elden-hole; 4. The ebbing and flowing well; 5. Buxton-well; 6. Peak's hole, and 7. Pool's hole. The first being a work not of nature but art does not come within the design of this account. Mam-tor is a huge precipice facing the E. or S. E. which is said to be perpetually shivering and throwing down great stones on a smaller mountain below it; and that nevertheless, neither the one encreases nor the other decreases in bigness. This mountain is composed chiefly of a sort of slate-stone (called in that country black-shale) and great stone. The nature of the black-shale is known to be, that notwithstanding it is very hard before it is exposed to the air, yet it is afterwards very easily crumbled to dust. Thus on any storm, or melting of snow, this shale is considerably wasted; and as the great stones are gradually disengaged they must necessarily fall down. That it is only at these times that the mountain wastes is affirmed by the most intelligent of the neighbouring inhabitants: and that this decay is not perpetual I can affirm myself; having not only taken a close survey of it, but also climbed up the very precipice, without seeing any other shivering in the mountain than what the treading of my own feet in the loose crumbling earth occasioned. That the mountain does not decrease in the mean time is a tale too frivolous to need any consideration.

Elden-hole is a huge perpendicular chasm. The depth of it is not known. Mr. Cotton tells us that he sounded 884 yards, and yet the plummet drew. But he might easily be deceived, unless his plummet was of a very great weight; for otherwise, I imagine, the weight of a rope of that length would be so great as to make the landing of the plummet scarce perceivable. Be that as it will, the depth of it is to be sure very considerable; and seeing we have no where in England so good an opportunity of searching the bowels of the earth to so great a depth, I wonder no curious person has ever had the courage to venture down. It is said indeed that a poor fellow was hired to be let down with a rope about his middle two hundred yards; and that he was drawn up again out of his senses and died a few days after: and no wonder, for the poor wretch having nothing else to reflect on in that dismal place, but the danger he had put himself into for the sake of a little money, might probably be frightened out of his senses. Or indeed the very fatigue itself might put him into that condition;

Fig. 30.



Fig. 29.

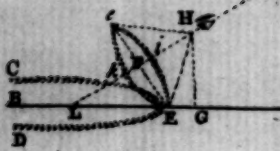


Fig. 31.

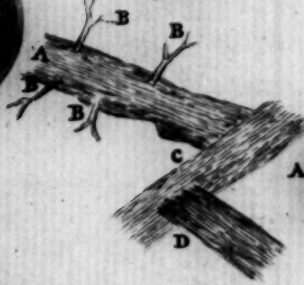


Fig. 32.

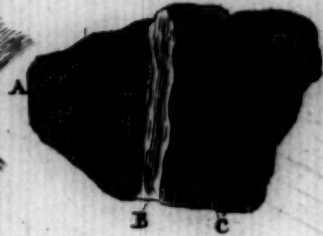


Fig. 34.



Fig. 35.



Fig. 36.

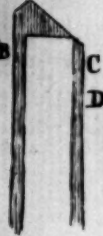


Fig. 37.

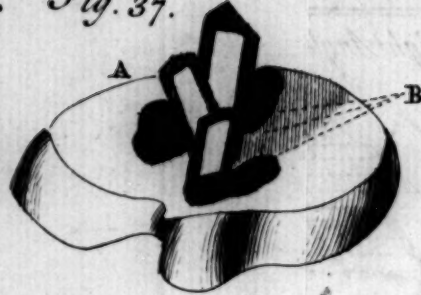


Fig. 38.



Fig. 39.



Fig. 40.



Fig. 41.



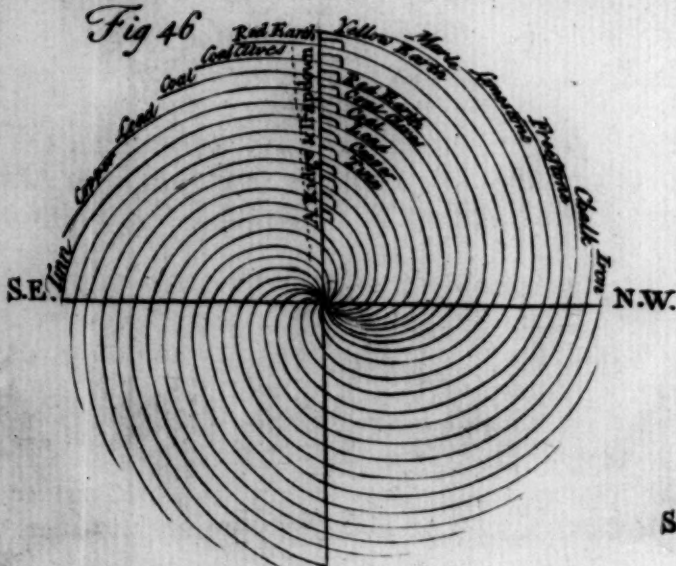
Fig. 42.



Fig. 43.



Fig. 46.



S.W.

Chalk
Freestone
Limestone
Marl
Yellow Earth
Red Earth & Okre
Coal Clives
Coal
Lead
Copper
Tinn
Iron

A Section of a Coal Country in Somersetshire about 20 Miles from S.E. to N.W.

Fig 44.



A Section of y^e same Country from NE. to S. Wony^e Drift or Level of y^e Coal^s at right Angles n^o y^e former

Fig. 45.

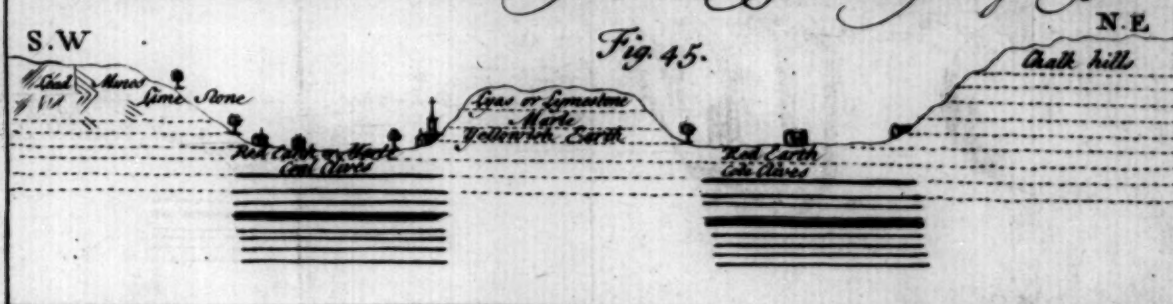


Fig. 48.

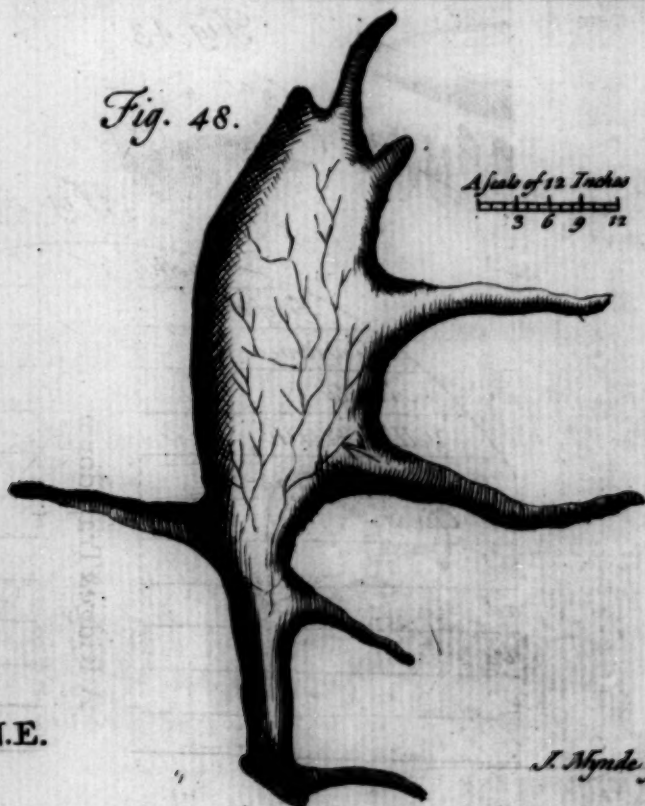
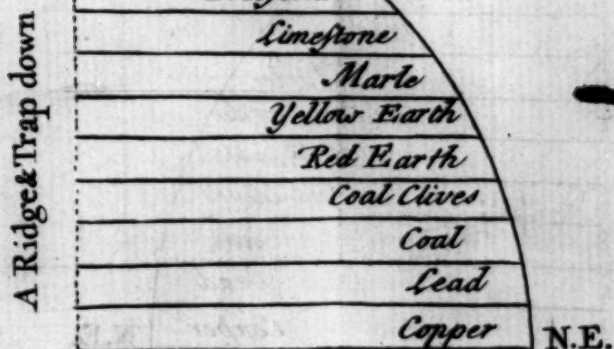


Fig. 47.



as any one will easily imagine who has been let down but a quarter of the way and drawn up again in that manner. But I conceive that if any intelligent and prudent person was to be let down in a proper machine, he would not be much in danger, and his fatigue would be very inconsiderable.

The ebbing and flowing well is far from being regular as some have pretended. It is very seldom seen by the neighbours themselves; and, for my part, I waited a good while at it to no purpose, and so I shall pass it over in silence.

Buxton-well has been esteemed a wonder on account of two springs, one warm and the other cold, rising near each other. But the wonder is now lost, both being blended together. The spring which is now used for bathing, appears to be $32 \frac{1}{2}$ degrees of one of Mr. Hawkbee's thermometers warmer than the common spring water there. *

Peak's hole and Pool's hole are two remarkable horizontal openings under mountains, the one near Castleton, the other just by Buxton. They seem to me to have owed their original to the springs which have their current through them. It is easy to imagine that when the water had forced its way through the horizontal fissures of the strata, and had carried the loose earth away with it, the loose stones must of course fall down; and that where the strata had few or no fissures they remained entire, and so formed those very irregular arches which are so much wondered at in these places. Whether this be the true origin of these caves or not I submit to those who shall hereafter have the curiosity to examine. It seems more probable to me than what others have hitherto proposed. The three rivers, as they are commonly called, in Peak's hole are only some parts of the cave deeper than the rest, and receiving all their water from the spring which comes from the farther end of the cave. The water which passes through Pool's hole is impregnated with particles of lime-stone, and so has incruited almost the whole cave in such a manner that it appears like one solid rock.

IV. INTER plurima mineralium genera vix datur aliud quod tanta nominum confusione intricatum, tam operosa explicatione indigeat quam Cobaltum. Veteres de cadmia & marcasita quædam murmurant; posterioris ævi viri de auripigmento, sandaraca, tutia, spodio, pompholyge huc miscuerunt sermones; tandem lapide calaminari, zinco, cobalto, auribus obstrepitum nostris est; & sub cobalto denique sunt qui jam vaporem metallicum, jam pygmæum subterraneum subintelligunt. † Jam quidem de eo saltem quod hodie, nostris imprimis, cobaltum appellatur agere proposui, atque dicam, si non plene, plane tamen, quod res ipsa sit, non curatis denique quæ de verbis moveri possint disputationibus.

*A Dissertation
on Cobalt.
By J. Hen.
Linckius.
n. 396. p. 192.
Nov. &c.
1726.*

† *vid. Hen.
kel. Pyritolo-
gia. Cap. 2.*

Cobaltum igitur est minera grisea, obscure albicans, minere argenti albæ & pyritæ albi quoad colorem æmula, sed paulò obscurior, continens arsenicum album & terram fixam, cum silice & cineribus clavelatis in vitrum cœruleum abiens. Effoditur

* The spring-water kept the spirit of wine at 41; the bath-water raised it to $8 \frac{1}{2}$.

Effoditur in Schneebergensium & Annæbergensium terris, imprimis in Cervi, Rappolti, centum millia equitum, Galilææ, & quotquot sunt, puteis; & quidem in venis propriis, idque ita purum putumque cum durissimo filice, seu quod vocant quarzo, ut si quæ fortè alia mineralium genera interspersa seu adfixa alicubi reperiantur, non simul cum vera cobalti substantia filici dicto innata, sed aliis ex causis, imo aliis venis associata non obscurè appareant.

Signorum externorum ejus proximum & indubium est minera quædam rosei coloris, structuræ radiatæ, quam cobalti florem, vocant; inter egregia & spectatu digna in mineralium gazophylaceis recondita. Hujus operis datur & alia, coloris verò non adeo rosei nitidi, sed pallidioris, nulliusque structuræ, sed pulveris instar mineram ambientis.

Signum propius præbet accurata ocularis collatio mineræ hujus cum pyrita albo; accuratior cum minera cupri grisea; accuratissima cum minera argenti alba; cum quibus rebus interest ipsi non levis coloris similitudo, essentiæ maxima differentia; quod verò verbis nec exprimi nec concipi satis potest, ita ut frequenti opus sit intuitu.

Signum proximum seu res ipsa manifestatur ex vitro inde confecto, quod ex pyrita nigrum, ex dicta cupri minera rufum, ex argenti alba & cupri particeps minera jam magis minusque nigricans; ex cobalto vero sapphirinum prodit, unde & zaffera, tum pro cobalto tosto tum etiam pro vitro cœruleo in pulverem redacto, nomen ortum verosimile est.

1. Per se cobaltum auræ, pluviae, soli in cumulo diu expositum efflorescit rosei vel perfici coloris, qui dicitur flos cadmiæ, sed cum illo flore nitidiori antea descripto non confundendus. Ille ritè extractus reddit substantiam elegantissime rubram & ad hæc vitrioli obscurè viridis portiunculam, quæ merentur ulteriorem investigationem; mineræ autem non parvam quantitatem, tempus, assiduitatem & patientiam requirunt, cujus rei encheireses D. Henkel in Pyritologia sua compertas probe habet.

2. Spiritus nitri solvit illud cum impetu & effervescencia, v. g. vi. vel iv. partes ad unam, quatenus minera pura vel minus est; unde verò resultare solet solutio non unius coloris. Viridis nempe color vitrioli veneris prope est, si cuprum certè continet; quod apparet in illa cobalti minera quæ Kupfer-Nikel appellatur & adhuc cruda cupreum colorem præ se fert. Viridis tamen etiam provenit aliquando ex ea minera quæ tota grisea & nullatenus ad visum cuprea, quamvis ad colorem solutionis vitrioli martis puri accedens; tamen a cupri contactu non planè aliena. Obscurè flavescentem solutionem reperio optimam ad vitrum illud sistendum cœruleum. Rubicunda implicata sibi significat mineram bismuthi.

3. Solutiones cum alcali, v. g. oleo tartari per deliquium, præcipitata reddunt pulverem porcellanæ debitè applicatum egregiè cœruleum, si contigit, cætera paria, imprimis cobaltum selectissimum, atque igitur te expertum directorem esse.

II. 4. Aci-

4. Acidum vitrioli & salis communis adoriuntur quidem cadmiam nostram, sed non tam solvunt quam erodunt, inprimis vitrioli acidum, & in pulverem album reducunt; adeò ut spiritus nitri convenientior sit solvendæ cadmiæ.

5. In vase clauso, retorta lapidea loricata, vel sublimatorio alio, igne aperto debitè detentum effumare patitur partem volatilem arsenicalem, ab initio aliquantulum fuliginosam, imo & sandaraceam, atque ita sulphuris communis non planè expertem, quam maximè autem se colligentem in forma semimetallica splendida, regulina, foliata, qualis ex pyrite albo provenit, ubi verò splendor per dies, imo per horas evanescit, luculento indicio particulas aeras in substantiam illam habere ingressum.

6. In furno vero tostorio ubi flammæ igneæ mineram contingunt, adhærescit camino vel ductibus adstructis, sicuti pulvis cinereo-albicantis coloris qui colligitur pro conficiendo illo arsenico albo crystalino.

7. Remanet terra fixa, cinerea, vitrescibilis.

8. Minera bismuthi (de qua quidem hoc loco specialissimus sermo non est, tamen utpote cœruleo maximè inserviens non prætereunda) igne aperto facile effluere finit substantiam semimetallicam quæ bismuthum appellatur & ad alios usus venditur, & relinquit lapidem seu terram itidem griseam, & fixam.

9. Minera illa quantum possibile, si pura, segregatur ex cobalto strictè sic dicto ut bismuthum colligatur. Sed interdum, imo non raro illud ita inspersum & intertextum est ut separari ab hac minus planè queat; hinc in ollis vitrificatoriis subsidet substantia regulina coloris communiter albo-subrubicundi; quæ tamen rarò vel nunquam bismuthum ita purum est, sicuti hoc ex sua minera per se emanat, sed commixtam sibi habet peregrinam inter alia terram fixam cobalticam. Atque ita novis compositionibus vitrificatoriis iterum commiscetur. Subdividunt aliqui regulum hunc in marcasitam, & æscaldarium, quorum illa inferius hoc superius hæret.

10. Terra utrinque remanens fixa per se difficillimè vel planè non in vitrum abit, quamvis in furno vere vitrificatorio per 8 horas illam detinuerim, vix quod unam vel alteram maculam subcœruleam crucibulo Hassiaco adnotaverit. Et quoniam sabuli granula argillæ vasorum istorum inhærentia concurrunt, dubium adhuc manet utrum per se talis sit quæ sine addito cœruleum possit constituere vitrum; quin hoc negandum mihi inde videtur, quia massa ubi vas non tangit non nisi grisea est & manet.

11. Terra ista non planè sterilis, sed metalli particeps est. Quod cuprum hoc sit facile præsumitur, si non è colore solutionum, tamen ex vitro cœruleo planè inde confecto, & ex agnata cobalti minera, Kupfernikel. Quod verò paucissima metalli qualitas hic sit, non solum ex levitate terræ, sed etiam exinde apparet, quia neque ex cadmia

optima, neque ex agnata, utut à venere denominata, substantia metallica cuprea ullatenus elici & colligi potest. Quicquid autem de cupri portiuncula prætendi queat, illa tamen per se quæ sit definienda non est, nisi quod dicamus eam cadmiæ peculiarem esse atque specificam.

12. Datur cobaltum quod etiam intostum vitrum cœruleum porrigit, imo quandoque elegantius quam ubi tostum fuit; quod non ex aspectu mineræ, sed per experimentum discendum est.

13. Itidemque per experientiam elucescit cognitio circa ignis gradus & continuationem, siquidem alia minera longiore & brevior, fortior & levior opus habet tostione.

14. Adjuvatur & vitrificatio & coloris elegantia per additum pulverem arsenicalem, imo arsenicum crystallinum ipsum.

15. Opus est non solum in privato laboratorio variis, iisque tam secundum proportionem quam ignis modos & gradus & reliqua, experimentis; sed & in officinis cobalti ipsis, ut docimasta indefesse experiendo invigilet naturæ mineræ & affixarum, atque ita compositionibus & laboribus, utpote in re colorum quasi delicatissimis, rectè prospiciat, iisque ad votum minus succedentibus vel addere, vel detrachere vel corrigere aliter sciat.

16. Cobaltum igitur in hunc finem experturus, probe oculis considera illud, utrum & quam purum à lapide & adhærentibus, vel hoc minus aut quam minus sit: torre vel calcina donec fumi cessent; commisce pulveri remanenti silicis vel sabuli silicei purissimi, albissimi, 1, 2, vel 3 partes, cinerum clavellatorum vel partem, vel pro fluxilitatis mineræ gradu plures, misce probe, ingere in crucibulum, si datur, subtus conicum, quali utuntur cuprum experientes. Si bene fluxerit, quod baculo ferreo experieris, quodque ocus seriusque fit quatenus furnus & ignis sunt, exime crucibulum & frige factum vitrum scoriis separa; separatam pulverisa, non in vase ferreo, utpote colorem obscurante, sed, si adsit, in porphyrio, vel alio durissimo lapide; pulverem lava ab eo quod albicantis sive grisei coloris est, atque tum hoc, tum illud desicca; desiccatum utrumque trajice per cribrum angustissimum; quod crassum iterum tere cum aqua, desicca, donec omne comminutum sit. Tandem confer cœruleum obtentum tuum cum exemplaribus colorum quæ gradus, ordinem, titulos atque pretium suum publica lege jam constituta habent, & videbis quid cobaltum sumptum importet, & ubi error aliquis factus sit.

17. In grosso, ut aiunt, procedendi hic modus est. Cobalti minera è puteo tracta, ab heterogeneis omnibus malleo, quantum potest, separata, calcinatur in furno qui fornicatus, latus, plani ferè fundi est, atque ignem flammeum ab alio prope adstructo furno anemio super mineram recipit. Huic ex opposito furni anemii introitus apertus est, ubi quidam rutro cobalti terram circumvolvitur, quo ignis undiquaque in eam agat atque arsenicum eò melius disjiciat, donec non amplius fumet. Adhæc calcinantur silices electi purissimi, & jam candentes projiciuntur

tur

tur in aquam frigidam ut magis tractabiles fiant ; ita præparati tunduntur in pulverem seu sabulum. Tum cobalti tosti pars una cum filicum partibus ut plurimum tribus, & ut eo facilius fluat, cinerum clavellatorum parte una, in cista quadam commixta funditur in furno vitrificatorio, in magnis ollis, igne per 8, 10, imo 12 horas intensissimo ; atque operarius unco ferreo magma jam fluens strenuè circumagiter, ut omne in æqualem fluxionem abeat. Ubi tandem quam potest limpidissimè fluit, cochleari magno ferreo vitrum exhauritur, & in alvearium aquâ repletum projicitur. Vitrum ita magis friabile redditum tunditur malleo quem aqua agit ; tufum trajicitur per cribrum orichalceum. Remanens ulterius tunditur, & trajectum in mola cum aqua subtilissimè pulverisatur. Hoc lavatur tum ad absterfionem particularum salinarum, aliarumque fordium, tum ad separationem pulveris cinerei albicantis levioris à cœruleo. Tandem in vasa per centenaria conditur, & per totum terrarum orbem divenditur. Sicut verò hujus rei, atque hinc pretii maxima differentia est, ita vasa certis litteris notantur, ita ut O. C. significet Ordinair Cobolt, M. C. Mittel Cobolt. F. C. Fein Cobolt. F. F. C. Fein, Fein Cobolt. F. F. F. C. Fein, Fein, Fein Cobolt ; id quod vero ut pretiosissimum, ita & rarissimum est. Minera cobalti ita præparata, aliàs schmaltum, smalte, & mulieribus, blaue stârcke, quo utuntur pro linteis dealbandis, communiter appellatur.

18. Venditur & cobaltum tantum tostum & cum duabus vel tribus partibus filicum vel quarzi commixtum sub titulo zafflor, item zaffera, pro figulis. Ubi hoc meretur commemorari, quod pulvis hicce in vasis quibus devehitur tam compactum fiat & quasi concreseat, ut duri lapidis instar malleo opus habeat ad comminuendum.

19. Cæterum cobaltum per se argentum non continet. Quamvis enim detur ejusmodi vena ex qua nobile hoc metallum excoquatur, tamen non nisi per accidens fieri exinde liquet, quia eadem vena illic plus, hic minus, & ut plurimum planè non argentifera est.

20. Hoc non obstante argentum nativum super cobaltum non raro reperitur, quod verò non aliud quam hoc arguit, mineram illam argenti non incongruam esse matricem.

Tantum ferè est quod propriâ experienciâ de cobalto cognitum recensione dignum duxi.

V. Sóowár is an Hungarian word composed of So, salt, and Wa, burgh or town. It is a large village, about a quarter of a mile from Eper a city of the county of Saár, entirely peopled with officers of the excise and miners or wood-cutters, and is situated on the summit of a little hill with an agreeable prospect.

July 16, 1724, we came to Sóowár to view this celebrated salt-work, which furnishes the finest salt of the whole kingdom. Having communicated our intention to an officer of the salt-works and asked his leave to go into the cuts, he gave us two guards for guides. We

An account of the Salt-works at Sóowár in Upper Hungary. By Dr. E. Bruckman. n. 413. p. 260. Mar. & c. 1730.

first descended about forty fathom into the well by a rope, seated on what they call leathern dogs; after which we again descended one hundred fathom by holding ourselves against the wall and sides of the wells; and so continuing our journey under ground we found ourselves at last in the cuts, and saw all the allies cut in the finest rock-salt; in the midst of which there were here and there some veins of flint of a dark grey. The miners having cut this rock-salt, they draw it up by a rope and put it into a reservoir, where they cleanse it with salt water. They boil it afterwards with the same water until it becomes of the consistence of crystal, and then put it into vessels containing about 268 lb. weight each, which they send into Silesia and other countries.

In regard to the vegetable or fossil-salt, it is extremely white and transparent; in the salt-works of Marmar near Transylvania there are large entire mountains of it, sufficient to furnish the whole world; and when any is cut it grows again in a very short time: though it appears black at first breaking or cutting, yet in pounding it becomes extremely white: and so it is with that which they use themselves in Hungary, for they send all the salt of Sóowár into foreign countries. You find almost in every inn two stones like to those used for making mustard, between which they pound and break the rock-salt; they also keep in their stables large pieces of it, which the cattle lick at pleasure.

But to return to the salt of Sóowár, one finds sometimes in the cuts allies of rock-salt of the most delicate blue and yellow colours: we observed, that the salt of the first colour being exposed to the sun for some days lost entirely all that beautiful ultra-marine, and became white as the other rock-salt; but the yellow preserved its colour; yet when you pound them both together, the mixture is neither blue nor yellow, but extremely white.

Melissantes in his new geography, speaking of the Spanish salt-works in Catalonia, says that there is rock-salt, the colour of which is so diversified that it comes near the rainbow, having green, red, yellow, and blue colours, but that by first preparing and then grinding it it becomes white. This is also true of the red rock-salt of Saltzburg, which being pounded becomes white.

There is in this mine one very remarkable thing, and that is a chapel which can easily contain a hundred people, with an altar, a pulpit, a sacristy, chairs, and forms, all cut in the salt-rock. In this chapel they celebrate divine service once every year, the week after Epiphany, for the officers of the excise and the miners.

There are in these cuts four fountains of salt-water, which they draw up, in buckets made of buffalo's skins sewed together, by an engine worked by horses, and convey it by pipes into the boilers where the rock-salt is put to dissolve, and afterwards boiled 'till it crystallizes.

They

They find here also a sort of crystallized salt, like a crust sticking to the wooden pipes: the miners call it salt of crystal; it is very white and transparent.

But that which is most curious and remarkable in these subterraneous fosses, is the flowers of salt which grow like the beard of a goat, but these here are much whiter and much finer: one cannot find them in all the cuts nor at all times, but they appear and grow according to the temperature of the seasons, which in those parts is very wholesome. These sort of plumes of salt are very brittle, they melt also in moist places and dissolve into an evaporated oil, but are nevertheless the purest salt, the finest, the most acid, the whitest, and most beautiful; so that they justly bear the name of flower of salt.

The salt of Sóowár is esteemed the best of all Hungary. By express mandates of the Emperor the Hungarians cannot employ it for their own use, much less can any private person drive any trade in it on pain of banishment, but it is all exported into foreign countries, chiefly into Silesia, Moravia, and Bohemia. They make every year about 50000 tun, every tun containing 268 lb. but by an ordonnance of his Imperial Majesty, they are henceforward to boil about 100000 tun, to be exported as the other.

At Neusol we saw a statue of rock-salt as large as the life, which served as the barometer of the place; for when it begins to sweat or grow moist it presages wet weather; but when it is dry you may certainly promise yourself settled fair.

VI. 1. *EXIGUUM* quendam adamantem per microscopium contemplatus, in eâ adamantis parte quæ polita non erat & splendore carebat complures particulas oculis observavi; & adamantem ex parvis particulis compositum esse comperi. Verum cum hæc nondum mihi satisfacerent, adamantem in frustra confringere decrevi, ut illum in fragmentis suis considerarem.

Of the structure of Diamonds. By Mr. Anthony Leeuwenhoek. n. 374. p. 199. Nov. &c. 1722.

Ergo adamantem malleo impositum alio malleo semel iterumque percussus, qui sic percussus in quatuor aut quinque frustra diffiliebatur. Quod cum nondum mihi satisfaceret, & adamantem in exiguissimas miculas comminuere vellem, frustum quod cæteris majus erat duplici chartâ circumvolvi, ne quæ adamantis miculæ diffiliendo perirent. Hic ego duritiem adamantis admiratus sum: qui multâ vi aliquoties ictus, in quatuor tantum aut quinque frustra sine ullis miculis diffiliebatur.

Posteriora ista adamantis frustula microscopio etiam admovi: quæ cum perspecularer, pene omnia ex minutissimis particulis composita esse comperi. Cum autem frustula illa radiis solaribus objicerem, quandam quasi flammulam ex iis emicare videbam, & quidem majorem quam unquam vidissem.

Frustulum unum oculis notabam, quod locum fracturæ suæ, planæ quidem ac quadratæ, soli directe oppositum habebat: qui locus, quan-

tum:

tum visu dijudicabam, tribus aut quatuor pilis menti virilis latitudine respondebat. Ex hoc adamantis frustulo tanta ascendebat copia ardescientium flammularum, ut plures esse numero quam quadrīngentas judicarem. Flammularum istarum nonnullæ, sed numero paucae, sibi erant vicinius junctæ, & reliquis majores : unde concludebam ipsas adamantis particulas illic etiam aliis particulis majores esse vel ordinatius esse dispositas.

Exinde oculos converti ad aliud adamantis frustulum, paris circiter magnitudinis cum priori, quod radios solares itidem directe excipiebat ; & haud paucioribus exiguissimæ molis particulis constare comperiebam. Ex unâ frustuli illius parte eâque circiter dimidiatâ, species illæ ardescientium flammularum etiam exoriebantur, sed mole minores : in altera medietate flammula quædam cernebatur assidue se mobilisans, cum continuâ quadam coruscatione, quæ speciem habebat debilioris fulgetri.

Cæterum postquam ista adamantis frustula radiis solaribus subduxeram, adhuc multiformes rerum species oculis meis objiciebantur. Inter alia, ex singulis adamantis particulis flammula quædam in altum emicare videbatur.

Porro novem præterea adamantis frustula microscopio applicata habebam : & in eorum septem particulas illas agnovi quas speciem flammularum ejaculari dixi. In duobus aliis etiam particulas illas agnoscere poteram ex quibus adamantem compositum esse statui : sed illæ planitiem suam ita soli obversam habebant ut plures eodem tempore particulas dignoscerem.

Mihi autem peramænum erat spectaculum, tot intueri imagines flammularum quæ omnes colorem præferebant coruscum, & pleræque viridantem. Istud autem insolens mihi visum est, quod ad flammularum quarundam extremitatem talis perciperetur in aere motus ac vibratio ; tamquam si flammula adeo illic debilitata foret ut conspicua esse desineret. Præ cæteris autem admirabar, quod ex tali adamantis particulâ circumquaque ignis exiret, debiliter rutilans, sicuti cum fulmen è longinquo coruscare videmus. Quod quidem tam crebro intuentem me accidebat, ut oculos avertere non possem nisi jam fatigatos.

Verum tam jucundo spectaculo sæpius frui decrevi, & frustulum istud adamantis, donec sponte a vitro decidat, microscopio applicatum relinquere. Neque enim ope glutinosæ alicujus materiæ affixum est vitro : nisi quod vitrum, antequam illi frustum adamantis affigerem, humore anhelitus mei irrorassem.

Cum tam grato spectaculo solus frui non vellem, quæ modo relata sunt legenda dedi amico cui & microscopium in manus tradidi. Cumque post aliquantum moræ requirerem ; nonne omnia descriptioni meæ convenire comperiret ; ille prorsus convenire respondit, & admirationem suam super spectaculi insolentiâ confessus est.

Porro

Porro cum frustulum quoddam adamantis adhuc microscopio applicatum esset, cujus particulas, lamellarum modo sibi incumbentes, visu dignoscere poteram; haud abs re me facturum putavi si lamellas istas delineari curarem, quæ hic denotantur per ABC.

Fig. 49.

Deinde & aliud adamantis fragmentum microscopio applicaveram, cujus lamellæ invicem superstratæ sese oculis meis distinctissime offerebant; quæ hic designantur per DEFGHIKLM. In hac autem figurâ particulae illæ sive lamellæ, quæ per FG, FH, FI, FK, & L denotatæ sunt, reliquis aliquanto crassiores esse videntur: verum istæ particulae ex pluribus lamellis invicem superstratis sunt compositæ. In istâ vero fragmenti parte, quam inter DEFM exprimendam curavi, distinctissime apparent tenuissimæ lamellæ, ex quarum congerie totum adamantem concretum esse pro certo habendum est.

Fig. 50.

Inter hæc celebris quidam gemmarius ædes meas forte præteribat, quem ego ad convivendum adamantis fragmen, sicut microscopio applicatum erat, invitavi. Ille fragmen istud non sine admiratione contemplantus, quasdam se adamantum glebulas quæ sibi inutiles essent mihi missurum recepit. Nec multo post bina mihi mittit adamantum fragmenta: item exiguum adamantem, ex arte quidem politum sed sordidum, uti vocant, seu vitiosum.

Cum singula singulis microscopiis applicassem, primo fragmentum istud, quod per NOPQR denotatum est, delineandum curavi. Lineolæ quæ per totum hoc fragmentum excurrunt revera non sunt nisi lamellæ ex quibus adamantes constare modo dixi: & apertius conspiciendas se præbent ad PQ.

Fig. 51.

Cæterum ut eorum, quæ de hac adamantis glebulâ sive frustulo jam dixi, clarius atque distinctior sit perceptio; frustulum istud eadem prorsus magnitudine exprimi jussi, quam nudo delineatoris oculo, sine microscopii ope, offerebat: quæ vera frustuli magnitudo exhibetur inter ST. Istud autem tantillum frustulum ex tam multis tamque exiguis particulis compositum est, ut qui non viderit capere haud possit.

Fig. 52.

In altero adamantis fragmento, quod ejusdem propemodum magnitudinis erat, lamellæ dignosci poterant: & pars illius circiter quinta constabat quinquangulo tam polito, tamquam si ex arte lævigatum fuisset, nisi quod illi affixus esset perexiguus adamas, qui circiter quartam quinquanguli partem obtegebat; & uti clare visu agnoscebam, etiam ex lamellis, sive particulis lamellarum formam habentibus, concretus erat.

Quantum ad perexiguum istum adamantem; illum quidem ex arte politum, sed sordidum seu vitiosum esse dixi: sordidos enim vocamus dum vel subflavi sunt, vel rimis aut lineolis deformes: quamvis nonnullæ hujus adamantis rimæ atque lineolæ nudis oculis conspici non possent; imo, adhibito etiam microscopio visum pene effugerent.

Exiguus hic adamas erat quadrangulus: prope unum istorum angulorum, intra ipsum adamantem, varias vidi particulas ab invicem sejunctas;

junctas, nisi quod aliquantulum sese attingere viderentur; quod initio insolens mihi visum est. Particularum istarum maxima coloris erat subflavi, & altero circiter latior quam crassior: nec splendore cedebat vitro. Reliquis particulis variæ erant figuræ; nonnullis etiam par splendor ac primæ: nec pauciores esse judicabam quam viginti; licet delineator tantum numerum non exprefferit.

Iste conspectus hanc mihi persuasionem induxit; quo tempore materia adamantum productrix vagabatur in aere, exiguas illas particulas, quæ itidem adamantes erant, priori quem dixi adamanti adjacuisse: materiam autem adamantinam, quamdiu talis materia aeri infedit, istam adamantum congeriem paulatim circumvestiisse, & minores adamantes inclusisse majori.

Qua occasione recordor complures me habuisse crystallos montanas figuræ sexangulæ: in quarum nonnullis quasi inclusæ jacebant figuræ quædam perexiguæ & oblongæ, coloris subcœrulei; sed tam exiles ut, adhibito etiam optimæ notæ microscopio, vix agnosci possent.

Porro istius adamantis, quem vitiosum appellavi, veram magnitudinem delineari curavi: quam expressam habes inter V & W.

Fig. 53.

Fig. 54.

Deinde & perexiguos istos adamantes, qui in majorem adamantem inclusi exhibentur in icone 53, seorsum delineandos curavi; quos in icone 54 designatos vides per X Y Z A B C. Ubi per X Y Z denotatur exterius adamantis latus, quod licet ex arte politum, ope tamen microscopii conspectum, colorem tam fuscum præferbat. Per Z A B C D E isti denotantur exilissimi adamantes, quos in majusculo adamante velut inclusos latuisse præmonui.

Fig. 55.

Cum postea latus adamantis in icone 53 expressi, cui longe minores adamantes inclusos fuisse mox dicebam, ad microscopium admovissem, adamantem istum variis foraminibus pertusum esse comperi; quæ ego foramina tunc facta esse censui, quando latus illud poliebatur. Ita nimirum ut exiguiissimi, quos dixi, adamantes loca illa prius infederint, sed poliendo delapsi foramina illa sive puteolos produxerint, quæ foramina conspicua sunt inter F G H.

Porro exiguum illum adamantem, inter V W in icone 53 expressum, in latus suum verteram; & ubi crassiusculus erat, novaculum illi aptaveram, ut adamantem ipsum ictu mallei diffinderem: quod tamen, licet iterato tentanti, non successit.

Fig. 56.

Quare adamantem chartâ mundâ circumvolutum imponebam malleo; & alio malleo, crebrius tamen feriendo, diffregi. Postquam omnes diffracti adamantis glebularum diversis microscopiis applicaveram; unam, quæ plures quam reliquæ lamellas oculis exhibere videbatur, delineatori effingendam tradidi, quæ denotatur per I K L M. Haud tamen possibile delineatori fuit eadem perfectione glebulam illam exprimere, quâ sese oculis conspiciendam offerebat.

Cum autem microscopium cui frustulum illud iconis 56 applicatum erat, diversum esset ab iis microscopiis quorum ope alia adamantis
frusta

frusta delineari curaveram; delineator postremum hoc frustulum eâ magnitudine expressit, quam sine microscopio conspectum oculis offerebat: quæ vero frustuli illius magnitudo exhibetur inter N O.

Fig. 57.

Quædam ex his adamantum fragmentis, ope microscopii considerata, jucundos præbebant conspectus: quos etiam nonnullis talium rerum studiosis exhibui. Illis autem jucundissimum erat in uno adamantis frustulo tam multiplices agnoscere partes: imprimis etiam quod lamellæ ex quibus adamantes concreti sunt in duobus adamantum frustulis valde distincte possent internosci; nempe dum lamellæ istæ juxta ductum longitudinis oculis objiciebantur.

Exinde studium meum converti ad examen crystalli cujusdam montanæ, sex lateribus præditæ, cujus longitudo circiter respondebat latitudini duorum digitorum, crassitudo vero minori digito.

CrySTALLUM istam in complura frusta confregi, & frusta microscopiis applicavi; disquirere volens num & illa ex superstratis sibi lamellis composita essent: quâ ratione adamantes magnitudinem suam adeptos esse dixi. Sed, tametsi perquisitionem istam sæpius iteraverim, ne tantillam quidem lamellam in iis deprehendi. Istud autem in crySTALLIS, quas quidem præ manibus habebam, plerumque animadverti, in omnibus earum lateribus, quæ numero sena erant, transversas protendi lineolas, alias aliis situ aliquantulum superiores; tamquam si illic, incrementibus crySTALLIS, ortæ productæque fuissent: quâ super re, quantumcumque crySTALLORUM numerum ante consideraverim, atque confregerim, numquam ipse mihi satisfacere potui.

VI. 2. THE following account of the diamonds lately found in Brazil, I had from a gentleman newly come from thence. Near the Prince's town, capital of the county do Serro do frio, belonging to the government of the gold mines, there is a place called by the natives Cay the merin, where they used to dig gold for many years, as they also did from a small river called do Milho verde. The miners turned up the ground and sands of the banks of the said river to extract the gold therefrom, and by so doing found several diamonds, which then they did not prize as such; and though some of the miners kept several stones for their figure and curiosity, yet in length of time they neglected and lost them, 'till in the year 1728 a miner lately come to work there, and better skilled, judging them to be diamonds made experiments upon them, and finding them really so began to seek for them in the same ground and sand, where the former miners had ignorantly left them.

Of the diamonds lately found in Brazil. By Dr. Jac. de Castro Sarmiento. n. 421. p. 199. Oct. & c. 1731.

After they had thoroughly examined the places aforesaid, they began to search for them in the river itself, and do actually find diamonds there, but with more trouble and difficulty; for in the former places they found them together among the earth and sand, as they lay; but in the river, as the sand is more dispersed, they lie farther from one another.

Experience and common reason teach them that these diamonds are not the natural product of the place where they now are found, but brought thither by the current of the water from some other place, which they are using all possible diligence to find out. They have not yet discovered it; but their hopes are very much encouraged because there are in the neighbourhood several mountains where nothing is to be seen but solid rocks of fine crystal.

The diamonds that have been found are commonly from one grain to six carrats, some larger, and among these one of forty-five carrats. The colour, solidity, and other properties are the same as the oriental ones: only it was observed that these diamonds which lay most exposed to the air and sun were more scurfy, and so lost more in polishing than the rest.

A description of some curious crystals. By Dr. J. J. Scheuchzer to Sir Hans Sloane, Bart. n. 398, p. 260. Apr. & c. 1727

VII. In summis Grimsulæ jugis, paucis abhinc annis detecta est, nunc exhausta, in saxo medio crystallorum vena, quibus nec majores, nec puriores, vidit fortè orbis. Maxima earum pars ad 60 circiter centenarios in manibus est D. Frisching pastoris Hasleani, venales omnes, sed pretio, ut ex sequentibus patebit, haud vulgari, quod fortè, præter puritatem, excusat rara magnitudo. Præcipuarum en quam nuper ab ipso expetii possessore seriem!

Num. 1. Duorum vel $2\frac{1}{2}$ centenariorum, longa 2 ped. $9\frac{1}{2}$ dig. Peripheria 3 ped. $7\frac{1}{2}$ dig. limpidissima, hexagona. Pretium libræ $1\frac{1}{2}$ Ludov. aur.

Num. 2. Pondus 136 lb. longit. 2 ped. 3 dig. Peripheria 2 ped. 9 dig. Purpuræ quasdam habet ad marginem, purissima cæterum. Pretium libræ 1 Ludov. aur.

Num. 3. Pondus 135 lb. longit. 2 ped. 4 dig. Peripheria 3 ped. 2 dig. limpidissima, excepto apice; pretium libræ 4 Floren.

Num. 4. Pondus 96 lb. longit. 2 ped. Peripheria 2 ped. 9 dig. pretium idem.

Ita descendendo pergat ad 10 librarum pondus, qualitatis, proportionis, pretii varii.

A curious piece of amber enclosing the leaf of a plant. By Dr. J. Phil. Breynius. n. 395, p. 154. Aug. & c. 1726 Fig. 58.

VIII. Hæc ovalis ferme sed compressæ erat figuræ, & magnitudinis quæ in iconæ fig. 58. adjuncta exprimitur, quartam uncix partem crassitie æquans, illius generis quod falernum, à similitudine vini, salutatur succinum, & quidem satis perspicua & pura, neque vel levissima fraudis macula conspurcata. Includebat per totam ejus mediam longitudinem exporrectum folium aliquod botanicis pennatum, quibusdam etiam alatum, quamvis minus recte, dictum; quod eleganti sane spectaculo, obscurum quidem, sed aureo colore coruscans, à reflectione & refractione radiorum luminis, oculis spectantium clare sese offerebat. Folium hoc non integrum sed utraque extremitate mutilatum erat, ut ipsa indicat figura, quinque constans foliolorum oblongorum utrinque non nihil acuminatorum paribus s. conjugationibus, quorum quædam erant ex parte exesa et mutila, in costa communi

æpue

æque fere à se invicem distantibus. Situm erat in plano horizontali, quod in eo foliorum genere familiare est, præterquam quod foliola obliquitate aliquantulum ab eo deflecterent; nequaquam vero conjugationes foliolorum decussatim positæ vel ullo modo videbantur, quod in foliis quæ conjugata botanicis dicuntur semper obtinet; ut adeo folium hoc ex compositorum pennatorum genere esse nullum mihi restet dubium. Cujus autem exacte speciei sit determinare vix licet; quia multæ species hujus familiæ foliis vestiuntur sibi adeo similibus, ut etiamsi recentia difficile sit à se invicem distinguere; accedit quod nec venulæ foliolorum vel oculis microscopio armatis appareant, utpote quæ à succino olim liquido oblitteratæ & quasi incrustatæ erant. Quam proxime autem accedit ad folium securidacæ secundæ Clusii, f. coronillæ herbacæ &c. Tournefortii, quæ in dumetis Prussiae satis familiaris est. Ab altera parte inter bina foliola aranea satis clare conspicitur; ab altera vero parvula musca, sed hæc non nisi oculo lente armato.

IX. 1. ANIMALCULA quævis, insecta, pisces, cochleas & conchyliæ, fructus quoscunque, arbores, semina, & herbas in lapides abire & in faxeam mutari duritiem, experientia quotidiana & innumeræ res lapidea rigiditate asperæ passim obviæ testantur. Hæc petrificatio, f. solidum in lapidem transformatio, originem ducit a tenuissimo halitu calcario, aut alio calce gravido minerali vapore, qui se fumi instar in animalium quorumvis & vegetabilium poros ingerit, sedem ibi figit, ac vi subsalsæ duritiei lapidescere cuncta cogit. Neque enim aliunde arcessenda est causa cur pleræque sic dictæ petrificationes in montibus imprimis calcariis, aut etiam terra ubi lapis calcarius effoditur, in conspectum prodeant & ex iis eruantur.

Veram hancce & solidam mutationem imitatur alia, sed rûdior & imperfectior & quæ mutationem mentiatur, petrificationis species incrustatio dicta, quam efficit faxea in subtilem viscum soluta substantia, qui occurrentium corporum superficiiei tenacius ubi adhæsit lapideam iis crustam paulatim induit; haud secus ac fruges variæ, semina, corticesque condiri saccharoque induci solent.

Porro varia etiam salium genera, alumen puta, sal culinare, & vitriolum, simili donata virtute deprehenduntur. Hæc corpora quidem non in solidum convertunt lapidem, falsitudine tamen sua & constringendi vi obvia quævis ita condensant & indurant, ut nativa posita mollitie in lapideam duritatem deflectant.

Vitrioli autem, inter omnia salium genera, vaporem proclivem maxime & idoneum esse ad duritiem rebus quibuscunque hoc modo conciliandam, alia ut præteream, varia probant hominum membra, manus, pedesque, quæ fodina Fahlunensium cuprea, in aqua vitriolo foeta subinde occurrentia, præbet conspicienda; quæque vigore ac infusa facultate vitrioli adeo induruisse patet ut putredinis nescia corruptionem omnem morentur.

Illustre imprimis hujus veritatis documentum dedit ibi repertum haud ita pridem humanum cadaver, ante 50 circiter annos infelici ruina

*An account of
an human body
found in a
copper-mine.
By the Hon.
Adam Leyel.
n. 384. p. 136.
July, &c.
1724.*

obrutum contumulatumque : sed quod erutum integrum ac, five carnem five cutem respicias, mutationis omnis expers comparuit, præterquam quod corneam contraxisset duritatem.

Fig. 59.

Anni 1719 mense Decembri, cum Wrediani putei cuniculus *i* in alium *d* agendus ducendusque esset, in hoc puteo 82. orgyias profundo, in rupis ipsius confinio *l*, sub aqua & 5 orgyiarum ruina, defuncti hominis corpus in conspectum venit. Utrumque crus cum brachio dextro & capite avulsa petrae moles contuderat : facies vero corpusque reliquum cum veste integra plane & intacta cernebantur ; habitusque totus viri collariae fasciae ora extremâ, sinistrae manus ope, os obturantis is erat quem litera *k* exhibet. Crumenâ quam gerebat pyxis ex orichalco oblonga, pyxide vero tabaci condebatur frustulum, utroque illaeso & integro ; ductitium autem ferrum, quo ad pyxidem annecti operculum volvi solet, aqua tincta edaci vitriolo totum absumferat. Caro hominis cutisque asperae licet & durae palparentibus viderentur, non tamen lapidis ea erat durities, sed corneae aut ungulinæ, etiam specie, suppar, quippe quæ cultro cederet scindique posset.

Post extractum tumulto fodinae corpus, diligenti examinatione quaesitum est ecquis esset qui agnoscere posset defunctum, aut quando periisset scire ? cum Magnus Johannis, metallicus quidam, probe illum a se de facie, quippe quæ lineamenta omnia illibata servet, agnosci, idque coram confesso metallico profiteretur ; subjungens etiam nomen vocatum eum aiebat Matthiam Israël, alias, ob proceriorem paulo staturam, Matthiam Magnum seu Procerum. Succurrit porro Matthiam hunc Israël, postquam anno 1670 & tempore quidem autumnali solus capsula vectus descendisset in fodinam, desideratum dubioque procul ruina suffocatum fuisse. Dictis fidem fecere idem affirmantes Ericus Michaëlis Prætor metallicus & Ericus Petri restiarius. His accedebat vetula quacum vivus adhuc Matthias sponsalia contraxerat, quæ veteris & jam reviviscentis amoris jure exanime corpus sibi concedendum aut terræ saltem mandandum postulabat. Aderant & alii plures illum qui agnoscerent & narrationis hujus veritatem confirmarent.

Quadraginta novem adeo annorum spatio, ab anno videlicet 1670. ad annum 1719. sub terra delituerat Matthias hicce Procerus, e qua in lucem protractum, in perpetuam rei memoriam, vetus ædes fodinae publica excepit : in qua hodieque integer, & tam quod ad vestimentum & lintea quam carnem, cutem, capillum, & ungues incorruptus foetorisque omnis expers oculis intuentium sistitur ; solo aquæ vitriolo abundantis ministerio exsiccatum & contra putredinis vim munitus.

Ex fideli hac certaue, quantum quidem ex loci ipsius incolis hauriri potuit, notitia haudquaquam petrificatum cadaver hoc aut in lapidem mutatum, sed aquæ tantum vitriolo scatentis beneficio induratum esse liquet. Quid quod vitrioli naturæ & ingenio magis nil quam ejusmodi petrificandi vis repugnat : quippe quod nil unquam in saxum

um

um convertat; tenuissimi vero vaporis vegeto motu omnia perumpat, stringat, ac a putredine interituque tueatur.

IX. 2. Ex hominum diluvio submersorum genere paucae superstites sunt reliquiae. Neque ego hactenus in numerosa satis collectione plures habui quam binas dorfi vertebrae, atronitantis splendoris, petrefactas. Nunc autem, ἀγαθὴ τύχη museolo meo illatum est lapidi fissili Oeningensi immersum λεῖψανον omni attentione dignissimum, in quo distincte cernere licet, non vagae imaginationis simulacra, sed capitis humani à quovis alio animantium genere distinctivi partes bene multas reapse residuas, cranii ambitum, os frontis, ossa sincipitis, occipitis, orbitam oculi, baseos cerebri & medullae oblongatae λεῖψανα, prominentiam interioris ossis occipitalis quae cerebelli lobos separat, colli vertebrae numero 7 partim denudatas partim lapideo cortice tectas, & est haec veluti orthographica sectio posterioris capitis partis.

Part of a human Skeletons petrified. By Dr. J. J. Scheuchzer to Sir Hans Sloane, Bart. n. 392. p. 38. Jan. &c. 1726.

Sed inde ex quo monumenti hujus fui potitus novus ex dicta lapidina advolavit hospes, carior tantò quia est ex rarissimis, omnia secum portans, priorem vincens & magnitudine, & aetate, & curiositate. Adfunt nempe in dicto fissili lapide demersa, ex hominis adulti sceletto ejusve structura anteriore, peripheria ossis frontalis, os jugale, orbitae oculorum, cranii tabulae cum diploe, vestigia foraminis infra-orbitalis destinati pro transitu nervorum quinti paris, reliquiae vel ipsius cerebri vel durae matris, ossa cribrosa & spongiosa, os vomeris nasum determinans, ossis quarti maxillaris portio quae genas constituit, nasi reliquiae, masseteris portio, sectio orthographica transiens per apophysin condyloidem maxillae inferioris ad angulum usque hujusdem maxillae, vertebrae in continua serie numero 16, pleraeque cum processibus transversis, claviculae dextrae extrema portio quae scapulae necitur, sinistrae media portio lapide tecta. Ex qua sceleti proportionem judico integram hominis staturam fuisse eandem quae incirca mea est, 58½ pollicum Parisiensium.

X. THE following paper is extracted from a book entitled, Dominici Bottoni de immani Trinacriae terrae motu idea historico-physica. It contains an accurate historical account of the several violent earthquakes which happened in Sicily, in the years 1693, 1694, and 1717, interspersed with philosophical digressions concerning the causes and effects of earthquakes in general. I shall be particular as to the former, which is the most material, as well as the most curious part of the book; avoiding however with all possible care an unnecessary repetition of what hath been already mentioned in another account of those two dreadful succussions, which happened the 9th and 10th of Jan. 1693, written by Vincent. Bonajutus a Sicilian nobleman, communicated by the late learned Marcellus Malpighius, and inserted in the Phil. Transf. N^o 207. p. 2. †

Of earthquakes in Sicily, their causes and effects, By Dr. J. G. Scheuchzer. n. 384. p. 151. July, &c. 1724.

The summer season in 1692, was exceedingly hot and tempestuous, with frequent thunders, lightnings and rains. About the middle of

† Vol. II. P. II. C. III. § xvii.

Sept.

Sept. fell such profuse showers that all the rivers encreased so as to overflow their banks in several places, and cover large tracts of ground with water. This joined to the continual blowing of southerly winds during the autumn put the inhabitants under great apprehension of future mischiefs. And indeed, the disastrous fate which befel Sicily about the beginning of 1693 too manifestly proved that this ominous fear was no way groundless. For on Jan. 9, about the 5th hour (according to the Italian way of counting) after a warm, serene, and calm day, the earth began trembling all of a sudden, chiefly about Catania and the neighbouring places, which continued as long as one would be in saying the Lord's prayer. This first shake was accompanied, as generally happens in earthquakes, by a hollow, thundering noise, and succeeded by another small trembling observed only by some few people on the 10th, early in the morning. These two succussions though violent enough were but a prelude of the third, which happened the 11th of the same month at four of the clock in the afternoon; of which the apprehension was so much the greater, because all the 10th and 11th, between the first and third shake, the air was more than usual dark and cloudy. This last was stupendous beyond human imagination, and it would be a task too difficult for the ablest pen to describe all its dreadful effects; the violent tossing and dancing of the earth; the hollow, thundering noise threatening the whole island with entire dissolution; the fiery eruption of the burning *Ætna* throwing out a prodigious quantity of flames, stones and ashes; the terror and confusion of the distracted inhabitants running up and down the streets, uncertain where to provide for their safety or escape the fury of all the raging elements which seemed to have conspired their ruin. There was scarce one place all over the kingdom left without some particular misfortune, Catania, Syracuse, Augusta, Messina, Noto, Ragusa, Leontini, Ibla, Chiarumonte, Carleontino, Caltagirone, Soctino, Francofonte, Bontello, Militello, Occhiali, Aydonò, Mottica, Mascali, were all if not entirely destroyed at least miserably shattered, many churches and stately buildings in several parts of the country violently thrown down, and above 60000 inhabitants buried under the ruins, of which about 16000 perished at Catania only.

In many places the earth gaped prodigiously. Such an opening was observed near Messina in the very bottom of the sea; another near a village called Botto d' Aceto, 250 paces long and near 8 palms broad; another at Caltanissetta near the Jesuits college, 2000 paces long and 2 palms broad; another at the top of a hill near Leontini, full wide enough to hold a man; another upon the road between Catania and Leontini, which swallowed up some mule-keepers then happening to travel that way, together with their mules and whole baggage, with a great many more of less consideration.

Out of all these openings sprung forth a great quantity of water which drowned the neighbouring places. This water was in some places hot, with a strong sulphureous smell, which lasted even after the earthquakes were over and induced some of the inhabitants, not without success, to make use of it in curing of ulcers and other cutaneous diseases, for which chiefly a hot well near Lazaretto became very famous. Out of some of these gapings of the earth issued a thick stench and smoke very noisome to all the neighbourhood. This happened, amongst other places, upon a mountain called S. Theodor, as also near Mena. Near Agoſta it was preceded by a sulphureous red flame.

Just at the time of the second shock the sea retired from the land all along the coasts, leaving its bottom bare for a considerable distance, and in a few minutes returned again with great fury overflowing the shores. By this accident the Maltese gallies lying at anchor in the harbour of Agoſta were in danger of being lost; for the sea sunk down all of a sudden so that they came to sit almost upon the ground, and immediately after boiled and swelled up again with so great an emotion that they run the hazard of having their cables broke and being driven ashore.

It seemed that the earth itself was in some places considerably lowered, and the tops of the mountains depressed. Of this they had a remarkable instance at Paternione. The hills between this city and the shore hindered it from having any view of the sea, which since the earthquake discovers itself towards the east very plainly.

In other places the earth actually sunk down and instead of it appeared great lakes, some of which were large enough to become navigable. By the breaking forth of such a lake between Noto and Syracusa, a large piece of ground was transported for about 50 paces, where it now stands as firm as if it had always stood there.

The loosening and fall of two great rocks between Terula and Cassero is already sufficiently described in the abovementioned account of S. Bonajuti: such loosening and throwing down of rocks happened every where up and down in the country to the great terror of the neighbouring people. The same has also been observed, according to Kircher and other authors, in some earthquakes in the kingdom of Naples. Two very high rocks near Ibla, with all the trees growing thereon, were by the violence of the fall quite inverted, so that the top stood upon the ground.

About two miles from Mena lies a lake full of bituminous, sulphureous and combustible matter, formerly famous under the title of Lacus Palicorum. Upon this lake there was observed, about a quarter of an hour before the second shock, a great red flame like a fiery column of about three yards perpendicular height, which during the earthquake suddenly disappeared.

At Agosta the misfortune was so much the greater, because, besides all the dreadful effects of the earthquake itself, the powder-magazine in the castle by some ill accident, and perhaps by the violent fall and striking together of the stones of some ruined buildings (or by the breaking out of some subterraneous flame) unluckily took fire, whereby the whole castle was blown up with such fury that some of the stones were carried as far as the island Thapsus, which is near eight Italian miles distant. By this accident perished 1840 inhabitants.

There remains still one thing worth observing, and that is the very rise and progress of this terrible succussion. It arose in the south, and proceeded from thence towards the north. For it was first observed in the island of Malta; then in the southern parts of Sicily; and last, always with some difference as to the time, in its northern parts. But the shakes were less violent the more it approached to the north. For the rest, it extended itself so far that not only the island of Malta, but also Calabria and some parts in the kingdom of Naples felt its fury.

Nor was this the end of our miseries: for the earth continued trembling during the whole year 1693. In the remaining part of January, and from that time to the beginning of the summer, the shakes came strong and thick, with hollow terrible noises and frequent eruptions of *Ætna*. The most considerable were observed Feb. 15, in the morning; March 1; March 18 at one o'clock; May 10; May 26 in the morning. Towards the end of the summer the shakes were observed to lose a great deal of their force, and *Ætna* to throw out flames and ashes in less quantity, when on the 4th of September this ignivomous mountain, having been some days before very quiet, trembled and cracked all of a sudden with a noise as if some thousands of cannon were fired all at once. This was succeeded by a new opening about 1000 paces distant from the old mouth, out of which immediately issued a thick stench and smoke followed by a great flame. It opened also in two other places with the like noise and eruption of smoke and fire Sept. 25, 1693, and Apr. 1, 1694. After that time the shakes became sensibly weaker and weaker, and at last entirely wasted.

The earthquake which happened Apr. 22, 1717, early in the morning was much the same with the former, though far inferior as to the degree of violence.

Concerning the causes and effects of earthquakes in general he observes, that such countries as abound much with fossil-coals, as England, some parts of Germany, and Sicily itself, are more subject to tremblings of the earth than any other.

That pestilential and other diseases which frequently follow great earthquakes are rather to be ascribed to noxious and infected mineral effluvia,

effluvia, which upon such an occasion issue out of the earth through the several openings, than to the putrefaction of the dead bodies which perished in the earthquake and were buried under the ruins of destroyed buildings.

That amongst the minerals hidden in the intrails of the earth some are combustible, some not; that of the combustible ones, as sulphur, bitumen, alum, vitriol, salt-petre, &c. some take fire quicker than others; that some as coals, are with greater difficulty to be inflamed, but keep the fire so much the longer; that the heat and sulphureous smell of the waters which broke first through the openings of the earth probably depends upon the mixture and fermentation of some of these minerals.

That Baccius, Kircher, and others, who draw the origin of the abovementioned sulphureous lake near Mena and of several others in other places from the subterraneous cavities of *Ætna*, are much in the wrong, there being not the least necessity of its being derived so far, since the country every where abounds with combustible minerals which rather seem to entertain and nourish the fiery eruptions of *Ætna* than to be occasioned by them.

That the sea's retiring from the shore and sinking down is the less to be wondered at, since there are many examples in histories of whole towns and islands swallowed up by it. This misfortune befel, according to Pliny, Tyndarida, formerly a famous city in Sicily.

That in all probability Sicily itself, which, by the testimonies of many, both ancient and modern authors, appears to have been formerly annexed to the continent of Italy by a small neck of land between the cape of Messina and the lower parts of Calabria, was separated from it by some violent succussion of the earth.

That *Ætna*, far from being the cause, as some imagine, of the earthquakes which so often desolate the kingdom of Sicily, seems rather to have been created in order to secure this island by its fiery eruptions from more frequent misfortunes.

That contrary to what Aristotle and some others assert, solid and rocky places receive infinitely more damage by earthquakes than loose, sandy grounds. This appears by the ruins of Catania, Leontini, Agosta, Syracuse and Noto, which were all built upon a solid stony ground, whereas Messina though every where undermined by subterranean cavities was abundantly less shaken.

His opinion about the causes of earthquakes is, that the earth is shaken by the violence of subterraneous fires occasioned by the fermentation of the combustible minerals hid in its entrails, that the effects of earthquakes may in all regards be compared to the effects of mines, and that the causes of thunder, lightning and winds may be derived from the same principle.

*An account of
an island raised
out of the
sea in 1720.
By Tho. For-
ster, Esq; to
Mr. Machin,
n. 372. p. 100.
June, &c.
1722.*

XI. J. ROBINSON, master of a small pink-snow called the Richard and Elizabeth from Piscataqua in N. England, arrived at Tercera Dec. 10, 1720, near which island he saw a fire break out of the sea. The Governor hired him to go with the said vessel to view it, and sent on board sixteen sailors and two priests. His account of it is as follows. Dec. 18 we got under sail at 12 o'clock at night, and stood from Angras S. E. The next day at two o'clock in the afternoon we made an island all fire and smoak, bearing S. E. from Tercera, distance 17 leagues: we continued our course 'till the ashes fell on our deck like hail or snow all night. We bore from it, the fire and smoak roared like thunder or great guns. At break of day we stood towards it again: at 12 o'clock we had a good observation two leagues south from it. We sailed round it, and so near that the fire and matter it threw out had like to have done us damage: in which consternation we all betook ourselves to prayers, being in danger of driving ashore, 'till a small gale at S. E. sprung up and carried us clear to our great joy. The breeze was accompanied with a small shower of rain which caused a great dust to fall on our deck; with the said breeze we stood away for Tercera. The Governor informed us that the fire broke out the 20th of Nov. 1720, in the night, and that the prodigious noise it made caused an earthquake which shattered down many houses in the town of Angra and places adjacent, to the great terror of the inhabitants. We took several draughts of the island at several bearings in our sailing round, of which I have sent you a copy. Prodigious quantities of pumice-stones and half-broil'd fish were found floating on the sea for many leagues round the island, and abundance of sea-birds hovering about it.

Fig. 60.

*A large shoal
of pumice-
stones floating
on the sea. By
the same to the
same, ib. p. 101.
A very sur-
prising one.
By Jo. Dove
to Dr. Halley.
n. 402. p. 444.
Apr. &c. 1728.*

XII. 1. AN acquaintance of mine informed me, that in his passage from Cadiz to London the latter end of April 1721, he observed the sea from Cape Finisterre, almost to the chops of the channel to be covered with pumice-stones, some of which he gave me.

XII. 2. In the Lyell, Charles Small commander, bound to India, on the 22d of March 1727, at noon, being in the latitude of $35^{\circ} 36' S.$ and longitude $4^{\circ} 9' W.$ with variation $3^{\circ} 16' W.$ we discovered several pumice-stones on the sea; but not expecting any such thing at that distance from the land, (the Islands Tristan d' Acunha being the nearest, which I judged to bear from us $W. 9^{\circ} 10' S.$ Distance 186 leagues) we were in dispute what it might be; when about 1 p. m. we took up a piece in a bucket, the ship going then but three knots. Towards night it was spread all round us as far as we could see: the wind being variable from N. by E. to E. we stood to the eastward: towards morning the wind veering to the northward, we steered E. S. E. The pumice-stones were very thick, in drifts lying N. N. E. and S. S. W. and extended out of our sight at the mast's head, encreasing as we ran to the eastward. To the 23d at noon I made

our

our course S. $38^{\circ} 30'$ E. Distance 76 miles : latitude by observation $36^{\circ} 35'$ S. longitude $3^{\circ} 24'$ W. from the meridian of London.

On the 24th, clear weather and fresh gales variable from N. E. by N. to N. by W. with a long swell from the eastward. We continued our course E. S. E. 140 miles, the pumice-stones being thicker ; so that from yesterday noon 'till four this morning, some of the drifts were about a cable's length broad, and so thick that we could scarce see the water between them ; and there was much the same breadth between the drifts, with several pumice-stones interspersed. Towards noon I found the pumice somewhat thinner : latitude $37^{\circ} 35'$ S. and longitude $1^{\circ} 4'$ W.

On the 25th from noon 'till two this morning, had a fresh gale at N. and N. by E. afterwards little wind from W. to N. W. with a N. E. sea : we steered E. by S. 101 miles. In the evening the drifts were near as large as above, but towards morning decreased much ; so that about noon we were clear of these pumice-stones, several of which were as big as a man's head. We have sailed 317 miles since we first discovered them. They lay just in the track for ships outward bound, and we have no account of them before ; but all the ships that went out the same year, and since, if they went so far to the southward, have fallen in with them. In the morning we tried the current, but found none : and no ground at 130 fathoms. At noon latitude $37^{\circ} 54'$ S. longitude $0^{\circ} 38'$ E. The following evening variation $6^{\circ} 12'$ W. At noon I judged Tristan d' Acunha then bore from us W. $3^{\circ} 39'$ N. distance 256 leagues, supposing it to lie in latitude $37^{\circ} 5'$ S. and longitude $15^{\circ} 38'$ W.

XIII. THIS subterraneous fire was first taken notice of on the 2d of Aug. 1726, in a marshy field situated in the parish of Flinx-hill, about ten or twelve miles S. W. of Canterbury.

It began on the side of a little brook near the water, and continued to burn along its bank without spreading much for some days. Afterwards it appeared on the other side, and extended itself the space of some acres over the field, consuming all the earth where it burnt into red ashes quite down to the springs ; which in most places lay four foot or more deep. On September 24 I went to see it and found it had consumed, as well as I could guess by my eye, about three acres of ground.

It then burnt in many places and sent forth a great smoak and strong smell, very like that of a brick-kiln. It never flamed but when the earth was turned and stirred. For some space round where it was burning the ground felt hot, though the grass seemed no more parched than might reasonably be expected from the dryness and heat of the season. I caused it to be turned up in several places, and found the earth hot and wet near four foot deep, and much hotter about two foot than near the surface.

*A species of
subterraneous
fire in Kent,
1726. By Dr.
R. Nesbitt,
to Dr. Jurin.
n. 399. p. 307.
July, &c.
1727.*

When this earth was exposed to the air, though it was very moist and not hotter than you might easily bear with your hand, the heat encreased so fast that in a few minutes it was all over on fire, like phosphorus made with allom and flour. I took several pieces of the earth before I was able to bring one away, because of its firing; one piece, in particular, I gave to my servant, which firing in his pocket had almost burnt its way out before it was perceived.

The soil of the field is of the same nature with that they make turf of in Holland; the surface of it is always wet, except in extreme dry seasons. This year it was somewhat more parched and harder than usual.

I believe, from what has been related, it is not more difficult to account for this fire than for those which often happen in hay-ricks when the hay is stacked before it is thoroughly made.

*A shock of an earthquake in Kent, 1727.
By Mr. Edm. Barrell to Sir Hans Sloane
Bar. ib. p. 305.*

XIV. 1. I AM informed that a shock of an earthquake was felt very sensibly at a farm on a hill called Skeat-hill, about eight miles south-west from Dartford: and the same morning a piece of ground in a meadow in Farningham, about five miles south of Dartford, fell in, so as to leave a pit about eight or ten foot broad and near as deep; and being on the same level with the river it was (when seen that morning) filled with water within three or four foot of the top; though that spot of ground was supposed to have been as sound as any about it, carts having many times gone over it.

*An account of an earthquake in N. England Oct. 29. 1727.
By Mr. Ben. Coleman.
N. 409. p. 124.
May, &c. 1729*

XIV. 2. THE earthquake came suddenly upon us at Boston, between ten and eleven in a very still and fair evening Oct. 29, 1727; the stars so bright and glittering that many had taken great notice of them, and one or two persons that had been in places subject to earthquakes had said transiently, that if we had been used to have 'em they should expect one. This only general symptom of its approach I have heard of, namely, the most serene sky and calm air that was ever known, not a cloud nor scarce a breath of wind. And though this is not universally a symptom when earthquakes are coming on places, yet so far as I can inform my self it has often and for the most part been observed. It was so in the dreadful shake at Jamaica thirty odd years ago; and a most ingenious and observing friend of mine who had his leg broke on the point when it sunk and is still living tells me, that after that shock, which was followed with many tremblings and lesser shakes while his leg was healing, he could from day to day judge by the face of the sky and air whether there would be any tremor or jar of the earth. If there was any cloud hanging over the mountainous part of the island there was no shake that day; but if all was serene and fair he expected one, and it seldom failed. Yet it was not found so with us, though the tremblings returned often for some months, and at times for nine months after the great shake.

The

The town of Newbury, at the mouth of Merrimock river, about forty miles N. E. from Boston, is the place that seems to have been the center of the shakes felt by us. There the earth opened and threw up many cart-loads of a fine sand and ashes, mixed with some small remains of sulphur; but so small that taking up some of it in my fingers and dropping it into a chaffingdish of bright coals in a dark place, once in three times the blue flame of the sulphur would plainly arise and give a small scent, and but a small one. By this it seems evident that it was a sulphurous blast which burst open the ground and threw up the calcined bituminous earth. The family nearest to this eruption, it being in that part of the town where the houses lie at a distance from each other, were in the terrors of death; the roar and shock being much more terrible upon them than upon others: and yet upon us at forty miles distance, and upon others at forty and forty more, it was very terrifying and astonishing.

Five or seven small shakes were felt by us after the first and great one that night and the next morning; but these and other following rumbles and tremblings were louder and greater at Newbury and the adjacent places than with us; and they felt and heard many times when our parts did not; but yet from week to week we and the places about us felt and heard some of the greater tremors both by day and night.

I have made what enquiry I could concerning other places, and have received the following account from Mr. Lowell in Newbury.

As to any previous notices of the approach of the earthquake, I can find nothing to be depended on. The prognostications that have been among us all failed; such as the brightness of the sky beyond what was common; the twinkling of the stars, and the like. I certainly know that we have heard the rumbles in all weathers, cloudy, foggy, rainy, snowy, clear, cold, hot, moderate, windy, calm, &c. indifferently; and at all hours of the day and night: (though by the way, we heard these rumbles oftner in the night during winter, as I think, and since more usually in the day) also when the wind has been at any point of the compass, and at all times of tide; and as to the moon, equally when she was nearer or further from her change or full: neither in any particular weather, nor on any observable occasion were the shocks greater or rumbles louder. As to alterations in the air or water after a shock, I could never discern any; particularly as to the wind being raised after a shock when it was calm before, which some reported, I could never perceive the least difference.

One thing I may add here very remarkable and which may be depended on. About the middle of April, that fine sand which was thrown up in several places in this parish at the first great shock, Oct. 29, did actually stink to a very great degree, even so as to be
more

more nauseous than a putrefying corpse; yet in a very little while after it did not smell at all. How long it was before it began to stink I am not certain; I know it did not at first, and I believe it was covered with snow 'till a little while before: there is nothing of smell now. There has been no opening of the ground, throwing up sand, stopping or breaking out of springs, &c. as at first. If there had continued any sensible evacuating of air or other matter pent up in the earth, from the surface of the sea or land adjacent to us, at the times of our many rumbles and tremblings, we should have discerned it before now. Newbury is a spot of ground, and so are the adjacent towns, very much inhabited and continually travelled over; and as to the sea contiguous to these parts, it is full of our coasters by day and night; but neither on land or water have any sensible eruptions or evacuations been observed that I hear of.

Boston News-letter, Sept. 5, 1728, tells us, that they felt a shake of the earth at Newbury and Rawley on the Tuesday before about four in the morning, with a noise much like thunder.

An uncommon sinking of the ground in Kent. Communicated by Mr. Peter Collinson. n. 405. p. 551. Nov. 1728.

XV. IT is now about two years since the lands of Lymne in Kent sunk; which was the consequence of a very wet season, when the waters that had fallen on the up-lands and were not carried off by drains soaked into the ground in such quantities as to form a quicksand at some considerable depth in the earth (at least this is what we look on to have caused the phænomenon) which not being able to bear the weight upon it broke out at the side of the hill and raised the lower parts of it, letting the brow sink forty or fifty foot, as I guess.

The ground sunk in a night, and was not perceived by the farmer's family 'till they found the change in the morning, by their door-cases not suffering the doors to open. The house is strangely rent by this accident, and had it not been timber built must have fallen, as a mighty strong barn near it did which was built of stone, for one great crack of the earth went through the middle of it and split a large kitchen chimney from top to bottom.

Fig. 61.

a b c d the profile of the land.

a the flat land at bottom three or four mile from the sea.

d the flat land at top, stiff ground and rocky.

* the place of the farm at present, which not only sunk down from *d* forty or fifty foot, but was also moved somewhat towards *a*.

b the lower part raised to *o*.

Remarks on the precipices of mountains. By Dr. J. G. Scheuchzer. n. 406. p. 593. Dec. 1728.

XVI. THE mountains of Swisserland are much more abrupt and steep, and the precipices greater to the south than to the north, and westwards than eastwards. Many instances of this might be given in particular mountains in Swisserland, as the Gemmi, the Mons fractus and so forth; but it is also evidently true with regard to the whole. The highest mountains separate Vallesia, the canton of Uri, and the several leagues of the Grisons, from Savoy, Piedmont and the

the Tirol, which lie to the south, or south-east. Those countries are, as it were, one continued set of high mountains quite to the mediterranean sea, and the like structure seems to be continued farther on into that sea itself. The Pyrenean mountains also are but a continuation of that vast chain which begins in the Lepontiaë Alpes, or the mountains in the upper Vallesia, the canton of Ury and Rhœtia, and from thence spreads itself chiefly west and south. On the contrary to the east and north they break off by degrees into gentle plains, which appears evidently by the vast tracts of ground which the Rhine, for instance, and the Danube compass before they lose themselves, the one into the German ocean, the other into the black sea, whereas the Rhosne, on the other side, quickly and with a proportionable velocity reaches the mediterranean. The same observation, with regard to the abrupt steepness of mountains to the south and west, holds true in other parts of Europe, remarkably in England and Norway, more or less in other countries. And so far as our maps and the accounts of travellers go, the same thing is observable in other parts of the world, but most evidently in the high mountains of Peru and Chili in South America, which terminate very abruptly westwards into the Pacific sea, but gradually decline to the east into immense plains, watered by some of the most considerable rivers in the world, particularly the river of the Amazons and the Rio della Plata, which rise in the said mountains. Whether the depths of the sea correspond with the heights of mountains, must be left to future observations.

XVII. An Account of a book omitted.

Prodromus crystallographiæ. De crystallis improprie sic dictis n. 387. p. 272. commentarium. A Mauritio Antonio Cappeler M. D. & Centumviro Lucernenfi Lucernæ, 1723, 4^{to}. By Dr. J. G. Scheuchzer.

CHAP. IV.

Magnetics.

I. 1. **I**F it were known what point within the stone, and what point in the needle are the centers of the magnetical power, it would be easy to find the true powers of the magnet at all the distances observed. For want of that knowledge I have computed † the forces from the center of the needle and the extremity of the load-stone, and find that at the distance of nine foot the power alters faster than as the cubes of the distances, whereas at the distances of one and two foot the power alters nearly as their squares. To try whether

Magnetical experiments in 1714. By Dr. Brook Taylor to Sir Hans Sloane, Bart. n. 368. p. 204. May, &c. 1721. † Vol. IV. p. 11. Ch. IV. § iv.

the law by which the magnetism alters could be reduced at all distances to any one certain power of those distances, I sought those points in the needle and stone which being used as the centers of the power might have that property. But in that case I found the center of the stone must be carried quite out of its figure, to make the distances large enough for this purpose. From whence it seems to appear that the power of magnetism does not alter according to any particular power of the distances, but decreases much faster in the greater distances than it does in the near ones.

This seems to be confirmed by other experiments I made. The first was thus; I made a needle $\frac{1}{4}$ of an inch long, of very fine steel-wire, a foot length whereof weighed but a grain, which I lengthened by sticking a light piece of rush to it, so that I could observe the direction of the needle in all the trials with a radius of two inches. Instead of a magnet I used a touched needle of steel-wire, which I set on a perpendicular to the horizontal plane I made the observations on, by means of a frame I made to transport it from one place to another; the north end of the needle being placed downwards and made a little sharp, that it might mark the paper it was set upon in every position by pressing the top of the needle gently with the finger. The observations were made in this manner; after having taken notice of the natural direction of the small compass needle, I brought the perpendicular needle as near to it as I conveniently could, setting it in such a manner, that a line from the upper needle to the center of the compass might be perpendicular to the compass needle. Then observing the same caution (which was convenient to make the center of the compass serve sufficiently well to be esteemed its center of power) I placed the upright needle at several greater distances, every time marking the place in the manner already described, and observing the variation of the compass. By this means I got a curve pretty regularly and fairly drawn by points on the paper. And by examining this curve, compared with the variations of the compass corresponding to its respective points, I found that the magnetical power decreased faster at the greater distances than at the nearer. It is of little use to be very particular in the account of the several observations. I shall only take notice that at about two inches and a quarter distance the force did not alter so fast as the squares, and at ten inches distance, where the variation was one degree only, it altered faster than the cubes, the index of the power being about $3\frac{1}{4}$. The needle of the compass was so short, that to suppose its center of force to be either in the middle or at the extremity of it would not alter the index of the powers of the distances $\frac{1}{20}$ of an unit.

I made another experiment to the same purpose with a compass needle made of a slight piece of straw with a small piece of steel-wire fastened to one end of it, which was always kept in the same position,

being balanced between two perpendicular needles, one of which was moveable and the other fixed. The event was much the same as in the former experiment.

Endeavouring to find the true poles or centers of the magnetical power in touched needles, I made a needle of two inches long of the fine steel wire, which I touched with the south point of a small cap loadstone, applying the point of the cap only to the extremity of the needle without drawing it along. The needle so touched being laid gently on the surface of a stagnant water floated. I then applied to it successively the two ends of a touched needle, as near as I could without letting the needles touch. The result was, that the floating needle rested upon the respective poles of the other needle marked with the small letters *s*, *n*, *s*. So that by one touch with the loadstone, which gave the needle a north-pole at *N* where it was touched, it acquired three other poles, *s*, *n*, *s*, which we may not therefore improperly call its consequential poles. Having discovered these consequential poles I made some other experiments to discover more of the nature of them, as they are described in the figure. The needles were all of them two inches long, made of the same fine steel-wire, and the letters *N*, or *n*, and *s*, or *s*, denote the character of north or south belonging to the points marked; the great letters signifying the points the loadstone was applied to, and the small letters shewing the consequential poles. Fig. 62.

I. 2. QUUM motus quos vocamus attractiones frequentissimi videntur in natura & plurimi effectus ab hisce pendeant, ad eos animum advertere cæpi ut intelligerem quales essent, quænam eorum causa, & quibusnam proportionibus operarentur: cum vero in magnetibus videntur hi effectus fortissimi, suspicari cæpi an ex iis non aliquantum plus lucis sænerarer quam ex aliis corporibus; & an quod in majori gradu obtinet inter magnetes non obtineret in minori forsan inter quælibet alia corpora. Ad experimenta cum magnetibus igitur veni, plura diversa institui quæ infra describam, sed post plurimos labores videor illud tantum colligere posse, magnetes non agere in se aut in ferrum per effluvia quædam corporea, sed causam eorum esse penitus ignotam & forte non corpoream.

Primum igitur volui experiri an magnetes in se operarentur juxta certam proportionem in diversis distantis, vidique in Actis Britannicis N° 335. p. 506. * simile venisse in mentem experiuntissimo Hauksbejo, sed ipsum instituisse experimenta cum magnete & acu modo tali qui omnibus non satisfaceret accuratis rerum scrutatoribus, unde concludit tamen his verbis. "I see no reason to doubt but the proportions of this power will be regular and agreeable to the several distances." Quæ verba non adeo placuisse omnibus eruditis colligo, cum nobilissimus Taylor eadem experimenta repetiit N° 344. p. 294. † & alia reliquit observata.

By Dr. P. Muschenbroek & Dr. Desaguliers. n. 390. p. 370. Sept. & c. 1725.

* Vol. IV. P. II. Ch. IV. § iii.

† Vol. IV. P. II. Ch. IV. § iv.

Rem eandem aggressus sum methodo prorsus diversa, sic meditatus, si sumerem duos magnetes & unum suspenderem ex filo supra alium ad diversas distantias a se invicem, sique fili extremum annecterem bilanci, me ponderare posse quantitatem virium quibus magnetes in se agebant; neque successu caruit meditatio. Sumpsi accuratissimam bilancem, qua melior nullibi forte existit, & uni brachio annexui lancem, alteri filum longissimum plurimorum pedum, cujus parti inferiori adhærebat magnes nudus; filum longissimum feci, ne actio magnetis ulla in ferream libram turbaret experimentum; ideoq; selegi locum in quo ferri tam parum, ac in ædibus unquam seligi potest. Sumpsi præstantissimos magnetes perfecte sphaericos, terrellas vester Gilbertus vocavit, horum poli erant accurate in extremo utroq; axeos sphaeræ, ita accuratissime distantias amborum polorum mensurare poteram. Gravitationem magnetis primo reduxi ope ponderis in altera lance in æquilibrium; dein ambos magnetes posui infra se, & quia libra erat ope funis mobilis supra trochleam eam demittebam ad diversas distantias pro lubitu, & cum magnes suspensus ageretur deorsum attractus vi magnetis inferioris, semper imponebam tantundem ponderis alteri lanci donec vis magnetis cum pondere faceret æquilibrium: hæc tamen distantia mensurari non possunt nisi interponendo corpus cupreum tantæ longitudinis ac est distantia inter ambos magnetes ob oscillationes libræ, & quia in majoribus distantis magnetes minus operantur quam in minoribus distantis, æquilibrium libræ obtineri non potest nisi eo artificio. Ecce nunc tabulam continentem experimenta in diversis distantis pollicum & linearum, columna remotior continet grana quæ æquiponderant cum attractionibus in iis distantis.

Distantia. Attractionis

poll.	lin.	grana.	lin.	gran.
13 —	6 —	0	8 —	106.
12 —	0 —	0 $\frac{1}{10}$.	7 —	114.
11 —	0 —	0 $\frac{1}{8}$.	6 —	131.
10 —	0 —	0 $\frac{1}{6}$.	5 —	146.
9 —	0 —	0 $\frac{1}{4}$.	4 —	172.
7 —	6 —	1 $\frac{1}{2}$.	3 —	190.
7 —	0 —	2 $\frac{1}{2}$.	2 —	215.
	12 —	70 $\frac{1}{2}$.	1 —	250.
	11 —	78 $\frac{1}{2}$.	$\frac{1}{2}$ —	290.
	10 —	87	0 —	340.
	9 —	94	In ipso contactu, five	

Pollices sumsi Rhenolandicos, & grana sunt pondera nostra medica, quæ etiam summa acriceia prius examinavi ut essent vera & æque gravia.

Hæc experimenta institueram die 24 Dec. 1724. & animo adeo ad omnia attento ne hallucinarer ut vix speraverim melius fieri posse.

Sed

Fig. 50.

Fig. 51.

Fig. 49.

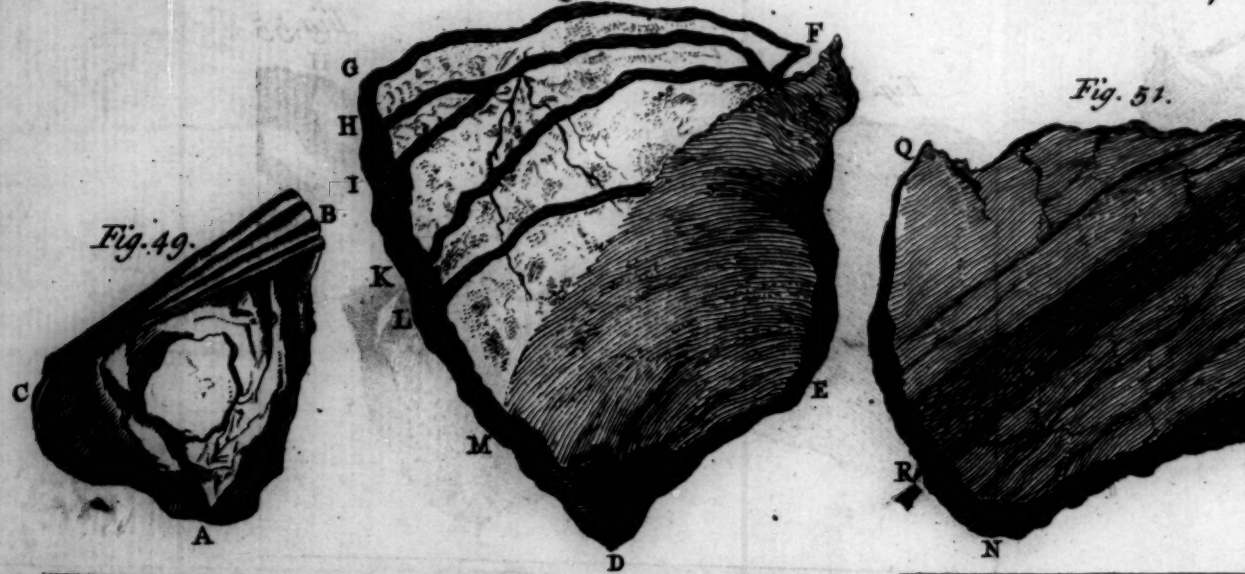


Fig. 59.

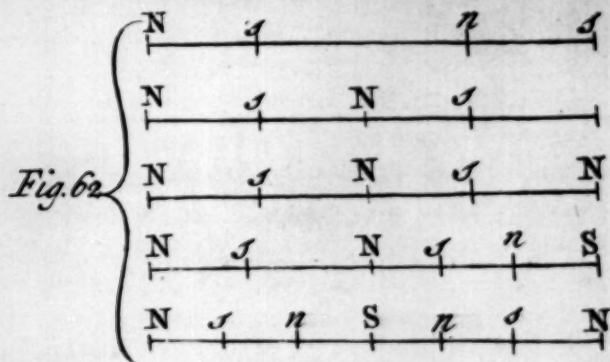
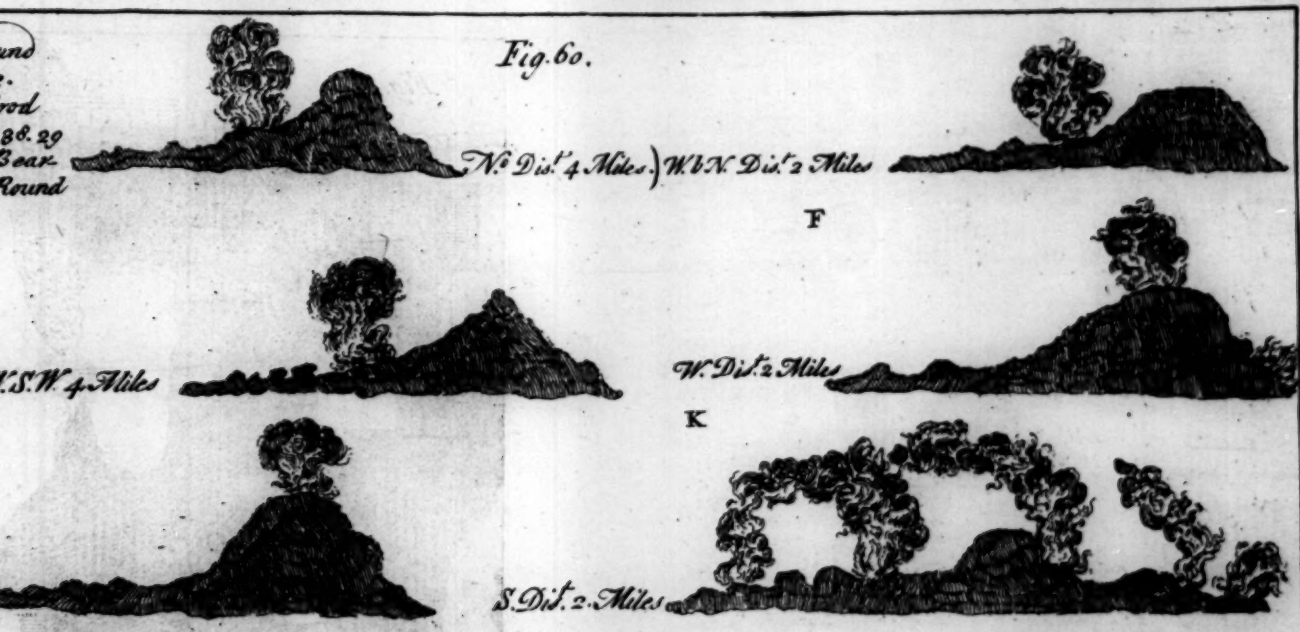
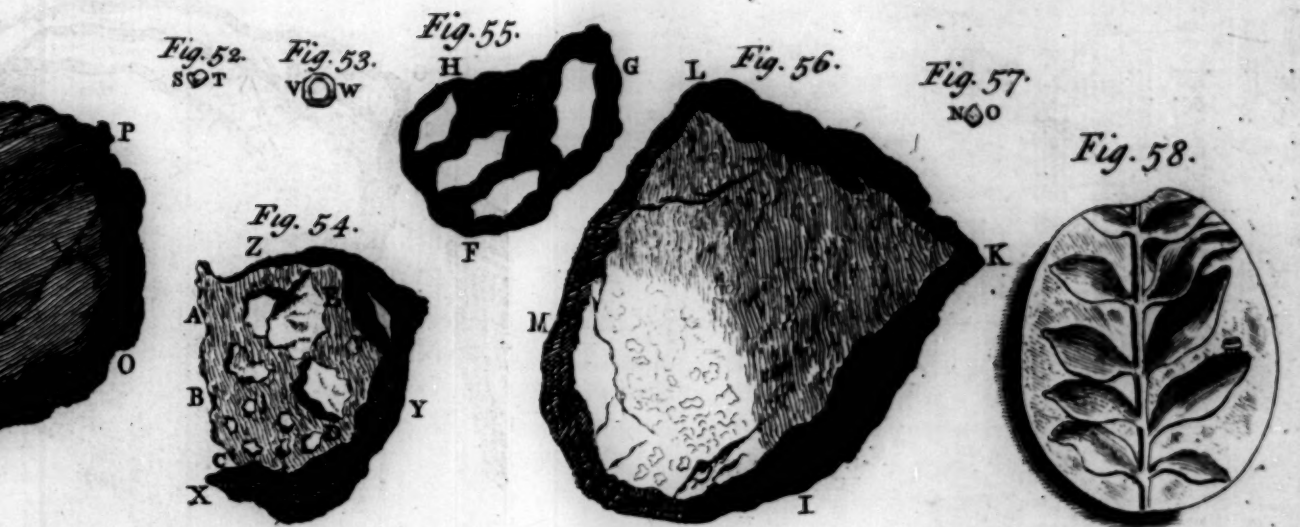


This Island is Almost Round
and Supposed to be about 2.
Leagues in Diameter By Good
Observation its Latitude is 30
Its Longitude 26.33 The Bo
ing Making it in Sailing Ro
is Express in the Draughts

W.S.

SW. Dist. 3 Miles





J. Mynde

Sed an ex his colligere possumus ullo modo dari proportionem inter vires & distantias? ego non video; tu vero perpende an aliquid regularis adfit, excute omnes proportiones, invenies nullas; evolve curvas cognitatas, nec felicius eruendo eris.

Postquam eo usque perrexeram suspicabar an non forte suspensus magnes esset heterogeneus utcunque, & an alius ejus substitutus loco eventum non daret magis prosperum, saltem ex quo plus lucis caperem, tædiosa enim nimis fuerant hæc experimenta quam ut inde tam parum emolumenti colligerem; sed ecce quid cum alio magnete parvo, admodum præstanti, observare datum fuit, dum magnes rotundus alius inferior idem maneret, firmiter in mensa positus: eodem autem modo experimenta instituta fuerunt.

Distantia.		Attractionis			
poll.	lin.	grana.	lin.	gran.	
5	— 10	— 1 $\frac{1}{2}$.	7	— 33.	
4	— 6	— 2 $\frac{1}{2}$.	6	— 38 $\frac{1}{2}$.	
3	— 9	— 3.	5	— 43 $\frac{1}{2}$.	
2	— 4	— 9.	4	— 50 $\frac{1}{2}$.	
1	— 9	— 12.	3	— 62.	
1	— 0	— 23.	2	— 79.	
	11	— 23 $\frac{1}{2}$.	1	— 140.	
	10	— 26 $\frac{1}{2}$.	$\frac{1}{2}$	— 186.	
	9	— 29.	0	— 340.	
	8	— 30 $\frac{1}{2}$.			

Sed irregularitates hic iterum adfunt maximæ, ex quibus concludi potest nihil: id solum est mirandum quod dum magnes pro hoc secundo experimento fuerat minor quam qui primo inserviverat, tamen in mutuo contactu viribus æqualibus attrahebatur, nempe 340 granorum, dum in aliis distantis longe minus tamen attracta fuit, uti ex comparatis ambabus tabulis patet: sed præterea hic minor magnes secundi experimenti multo generosior fuit & præstantior ad elevandum ferrum quam magnes primi experimenti.

Hæc experimenta repetii cum aliis magnetibus & imprimis uno cujus tanta vis ut acum magneticam inflectat ab ipso distantem 14 pedibus Rhenolandicis; nescio an similis descriptus ullibi habeatur: sed ex omnibus id modo concludere possum experimentis, proportionem inter vires & distantias dari nullam.

Quum tam declinatio quam inclinatio acus magneticæ variet singulis fere annis subiit quoque desiderium videndi an vis magnetis omni die esset eadem, an minor vel major æstate quam hyeme; sed vim esse minorem æstate quam hyeme me docuerunt experimenta multa, saltem de hac æstate loquor, an futuro anno idem obtinebit explorandum erit.

Sumsi igitur magnetes binos qui primo experimento inservierant, & eodem prorsus modo institui experimenta cum iis ac ante, dies vero fuit 11 Julii 1725, cum baroscopium esset elevatum ad 29 $\frac{1}{4}$ pollic. thermoscopium Fahrenheitii ad 62 grad. & ventus septentrionalis versus occalum, cælum siccum, serenum, & in eodem loco mearum ædium.

Distantia. Attractionis				
poll.	lin.	grana.	lin.	gran.
12 —	0 —	0	7 —	106.
9 —	0 —	1 $\frac{1}{8}$.	6 —	111.
8 —	0 —	1 $\frac{1}{2}$.	5 —	132.
7 —	6 —	2.	4 —	149.
7 —	0 —	2 $\frac{1}{2}$.	3 —	173.
	12 —	70 $\frac{1}{2}$.	2 —	205.
	11 —	75 $\frac{1}{2}$.	1 —	240.
	10 —	85.	$\frac{1}{2}$ —	270.
	9 —	92.	0 —	300.
	8 —	100.		

Constat quidem inter philosophos magnetis utriusque polos non agere æque fortiter, sed polos boreales esse fortiores viribus quam australes, sed hoc assertum quidem demonstratum accurate fuit nullibi; quia vero nostra methodus ponderandi vires magnetis satis facilis erat et accurate ejus ope determinari posse videbam, converti modo ambos polos amborum magnetum ita ut iterum duo poli amici sibi essent obversi, & in magnetibus hujus ultimi experimenti hæc observavi.

Ad distant. Attractionis

lin.	grana.	lin.	gran.
12 —	57.	5 —	101.
11 —	63.	4 —	113.
10 —	66.	3 —	124.
9 —	70.	2 —	148.
8 —	79.	1 —	168.
7 —	83.	0 —	228.
6 —	90.		

Ex his patet manifesto ambos polos magnetis non agere viribus iisdem, quanta autem intercedat differentia ex comparatione ambarum tabularum videre poteris.

Quum ab ineunte ætate qua primum operam philosophiæ dare inceperam in hunc usque annum mihi persuaferam actionem magnetum ab effluviis, vel aliquo saltem fluido pellente extus magnetem, pendere; neque videram præstantissimos viros aliter sensisse; experiri volui an ullo experimento hanc meam opinionem confirmare possem. Dum igitur

igitur experimenta priora cum magnetibus instituebam ad varias distantias à se mutuo, interposui frustra crassissima plumbi, stanni, argenti, cupri, mercurii massam insignem, visurus an his effluvia magnetica non impedirentur, & si non omnino, saltem aliquo modo; vitrum pellucidum est, lucem transmittit, tamen non adeo copiosam ac si nullum vitrum adfuisset; eodem credidi modo effluvia magnetica, si non prohiberentur omnino, saltem impediri aliquo modo ne magnetes tam fortiter ad se traherent, si plumbi frustrum 1 pedis cubici interpositum foret, vel si plumbum crassitiei 2 digitorum, & stannum ejusdem crassitiei, tum cuprum, tum massam magnam mercurii interponerem; sed vidi, quæcunque interposueram corpora, semper vires magneticas esse easdem ac si nullum corpus interlocaretur; hoc profecto mirandum existimo neque intellectum credo ab ullo mortalium: non enim fingere licet hæc corpora esse adeo porosa ut nihil solidi in se habeant; quod si igitur solidum habent, ut habent plurimum, an hæc partes non impedient quominus fluidum extraneum adveniat vel ex magnete exeat? non dico quod omne fluidum impedient, sed saltem aliquid, experimenta tamen omnia docent vires magneticas impediri nullo modo: vel an hæc effluvia erunt multo subtiliora luce? præterquam quod hæc esset iterum hypothesis, difficultas superior non tollitur; ignis impeditur à corporibus, lux non penetrat illico per omnia corpora, & ita se habent fluida omnia ut à solidis resistantiam experiantur, sed effluvia magnetica ita se non habebunt, immunia erunt resistantiæ à solido corporeo; hoc est ad quod mens nostra plane hebescit.

Sed argumentum fortissimum ex viribus repellentibus magnetum depromam, sunt hæc longe debiliores quam vires attrahentes, uti mox experimentis confirmabo, adeoque oportebit ut fluidum accedat ab exterioribus versus magnetem, quod dum occurrit alteri magneti unum pellit ad aliud, quodque magnetem ingreditur, & quia attractio magnetum est longe fortior quam repulsio, copiosius fluidum ingreditur magnetem quam egreditur: unde fieri non potest quin brevi magnes adimpleatur hoc fluido ut non amplius porosus maneat; nec statui potest quasi undiquaque ex magnete fluidum hoc exiret, nam fit attractio in omni puncto magnetis, & fit tantum repulsio in locis polorum. Ut vero demonstrem repulsionem magnetum esse minorem attractione eorundem, ecce tabulam continentem experimenta cum memoratis ultimis magnetibus facta.

Distantia

Distantia. Repulsionis			Distantia. Repulsionis		
poll.	lin.	grana.	poll.	lin.	grana.
13	— 0 —	0.	1	— 11 —	16.
11	— 11 —	$\frac{1}{2}$.	1	— 10 —	17.
10	— 9 —	$\frac{1}{4}$.	1	— 4 —	17.
9	— 9 —	1.	1	— 0 —	24.
9	— 0 —	1.	10	— 24 —	
8	— 0 —	1 $\frac{1}{4}$.	7	— 25 —	
7	— 0 —	1 $\frac{1}{4}$.	6	— 25 $\frac{1}{2}$ —	
6	— 1 —	2.	5	— 27 $\frac{1}{2}$ —	
5	— 1 —	3 $\frac{1}{2}$.	4	— 29 —	
4	— 0 —	6 $\frac{1}{2}$.	1	— 34 —	
2	— 9 —	11 $\frac{1}{2}$.	0	— 44 —	
2	— 3 —	13.	In ipso contactu.		

Ex his experimentis circa repulsum magnetum iterum videbis non posse deduci ullam proportionem, sed profecto magnetes esse corpora admodum miranda, de quibus huc usque pauca scimus, ignoramus plurima.

..... By Ser-
vington Sa-
very, F/q;
" 414. p. 295.
May, &c. 1730

I. 3. In my younger days I once diverted myself with making an horizontal needle, one of my school-fellows having a load-stone. Before I could have the use of the stone I often held my needle in its box with its intended south end near the bottom of a window-bar, and sometimes with its north end at the top, having seen one of my companions do so with a touched needle. I observed the needle, which was hung very tender, to make vibrations at either end of the bar. I happened to set it down in the window at a good distance from the bar and found the south end more inclined to vibrate to its bottom than the north end, and seeing it to have some vertue I thought of encreasing it by taking the needle out of the box and applying it to touch the bar with its proper ends. By this method alone it gained such a degree of polarity as would constantly turn its proper end to the north, if it was kept trembling; but if I placed its contrary end to the bar the polarity would be changed presently.

Having lately a fresh inclination to magnetical experiments, and reflecting that iron not having any fixed polarity, might (if it moved tenderly enough) conform its ends to the magnetical meridian; I touched a needle whose length was 2 $\frac{1}{2}$ inches and weight 12 grains, on a piece of common iron, which held with its length directed in the magnetical line, gave the needle vertue enough to vibrate about four times in a minute. I held the needle while touching in an horizontal situation with its north end directed towards the north, and placing its middle at the top of the iron drew it along southward: then placing its middle at the bottom of the iron, I drew it northward, that both ends might be equally touched.

Having

Having no other than a small loadstone of a very irregular shape, I was loath to diminish it enough to bring it into a tolerable figure to receive armour; and therefore only ground a little place plain at each pole, where I bound it on with thread. Its weight naked was 466 grains, its armed south pole would only lift 433 grains. Having observed that touched steel would communicate some vertue as well as attract, I got some large steel-wire, which having cut exactly into equal pieces I filed their ends as transversely as I could and very plain. Then having marked one end of each with a file I seasoned them very hard, and made them all over very bright. Each of them measured in length about 2.74 inches, and weighed 36 grains or more. With my loadstone I touched 37 of them, one by one, making their marked ends their south poles. I laid them side by side at about half an inch distance from one another on a board, with their marked ends toward the same edge thereof, taking care that they should not touch one another 'till they were all touched. Then having armour made in this shape  ready, I speedily thrust them together, and forming the bundle into a regular hexagon as soon as I could, bound them fast from end to end with the armor upon them. Finding this artificial magnet exceed my natural one, I held the artificial in one hand, and the natural in the other, with the north pole of the one against the south pole of the other, and placing their armour on the middle of one of my wires drew them asunder, and so touched both ends of the wire at the same instant. In this manner I touched a second set of wires one by one, which I managed like the first, and bound the armour of the first set to the second. The south pole lifted a key, weight Troy 1125 grains. Both poles united would with difficulty lift the same key with weights fastened to it, the whole 1 lb Troy or 5760 grains.

I next thought of mending this way of touching, by placing all the wires with their marked ends toward the north in a long small trench, to keep them from rolling away while I was touching them. I placed the two magnets at their conjunct middle, and then instantly and speedily drew one of them to one end of the wires and the other to the other end. I found this way not only more expeditious but more advantageous, giving all of them a stronger touch; only the wire at each end was not so strongly touched as the rest. One of these thus newly touched would lift a prepared nail 4.75 inches long, weighing above 426 grains Troy; which is $11.83\frac{1}{2}$ times its own weight. I placed the wires separately in the magnetical line for about two days, in which time all of them had lost some vertue, yet that which had lost most would easily lift a nail of $4\frac{1}{2}$ inches long, in weight 306 grains.

Having such success, I got seven round bars of steel all of one size and length, their diameters being about $\frac{1}{8}$ of an inch, and their lengths about.

about $12\frac{1}{2}$ inches good measure; I hardened and cleansed them as I did the wires, and laid them end to end in a trench planed for them in a long piece of wood about the depth of half their diameter, with their marked ends all one way; and putting a pin at one end to keep the bars from sliding to the ground I elevated the other end 'till it was in the magnetical line. I then touched them with two of my magnets as before, and this I found the best way of all. Being finished and armed, the north pole lifted above half a year after lb j. Troy, and the south pole considerably more. In making one of these I met with an odd accident; for after I had begun to touch it, apprehending it was a small matter bigger than the rest, I attempted to mend it on a grinding-stone whose axis was directed about 14 or 15 degrees from east towards north. I was not careful to keep its poles the proper way in grinding, but held it sometimes a-crofs to the stone which would make it jar, at other times with the north pole toward the N. Afterward I touched it again with the rest, but could not give it an attraction equal to that of the others: I happened to try with my dial-needle whether the change of polarity was in the very middle of the bar, or nearer to one end than the other, and found in it several poles. As I held it erect the bottom was a south pole, further up no attraction, the pole changing at about $\frac{1}{3}$ of the bar's length to a strong north pole, and about $\frac{1}{3}$ up to a strong south pole, and at the top to a strong north pole, the middle between each pole not attracting. Whether the jarring on the grinding-stone while held in a wrong posture was the cause of this irregularity, or whether I might at first touch it the wrong way, I know not; but I could not help it by touching: for as the vertue became stronger in the ends, so did also the polarities in the other parts of the bar. I tried to cure it by putting it over fresh wood-coals in an horizontal posture, with its intended south pole directed towards the magnetical north, and so kept it 'till it was blue, then I took it off and cooled it in almost the same posture. I examined it without retouching and found it perfectly cured, for the polarity was regular throughout, and it attracted full as strongly as any of the rest.

I next endeavoured to procure magnetism in steel, without the assistance of any magnet except the earth's central one.

Finding my artificial magnets would communicate more vertue to other steel than they themselves had, and observing that erect bars had some vertue from the earth's magnet, and would, when in an erect posture or in the magnetical line, give a small degree of fixed polarity, I got nine steel bars 0.75 of an inch square and 16 inches long, each weighing 3 lb Avoirdupois. Having made them moderately bright by grinding, and filed their ends plain and transverse to their lengths, I marked one end of each, hardened and scoured them bright and polished their ends very well. I fitted a piece of armour to each end of

one

one bar, and bound it fast; then holding one of the unarmed bars with its marked end northward, I elevated its south end 'till I guessed it was in the magnetical line; then taking the armed bar, with the poles of the armour downward, and the marked end toward the north depressed to the magnetical line, I placed the pole of the upper armour about four or five inches from the top of the unarmed bar, and as soon as ever it touched it, I drew it downward as fast as I could 'till I was past the middle, and from thence gradually slower to the bottom, where I let it rest about a second or two. In the same manner applying the pole of the lower armour to the unarmed bar about four or five inches from its bottom, I drew it upward speedily at first, slower when above the middle, letting it rest a little at the top. Having upwards and downwards alternately repeated the touch on the same side of the bar, I touched the opposite side in the same manner, and afterwards the two other sides. Then holding the unarmed bar erect, I tried if it had gained any fixed polarity by holding a needle at its top and bottom; for if it had it would attract the needle stronger when the marked end of the bar was held downward than when it was held upward; and when I found the armed bar had communicated to the other more vertue than was in itself, I took off the armour and bound it to that which was newly touched, and therewith retouched that which I had disarmed. In a few repetitions of changing the armour from bar to bar, and touching the weakest, I procured in both a fixed polarity to such a degree that the north pole held downward would attract the north end of the needle, though much fainter than if the north pole had been upward, and position did not now change their polarities but only weaken them; therefore I now call their vertue perfectly permanent. Four or five repetitions more encreased their vertue to such a degree that the south pole of one of them would lift a ten-penny nail prepared, and after two or three repetitions more a common door key weight Troy above 520 grains, not by the bow but by its lower end which was wrought somewhat globular and polished. With one of these armed I touched half a dozen bars laid end to end on a board elevated to the magnetical line, downwards with the north pole and upwards with the south: after several touches the south pole of one would lift another by its north pole. With one of these armed I touched a small square bar of steel in length 2.156 inches, in thickness somewhat more than $\frac{1}{4}$ of an inch, weighing 304 grains; it would lift afterwards an iron $5\frac{1}{4}$ inches long, weighing 2000 grains, which is above $6\frac{1}{2}$ times its own weight. With this little bar naked I touched a small steel needle, the socket being also steel. I seasoned it very hard and cleansed it well. It weighs not full four grains, has lifted two prepared six-penny nails, one at each end, while it was held in an horizontal posture with its south pole towards the north. It also lifted a key by the bow, as it was held perpendicularly with its

south pole downward, the weight whereof was 115 grains or better, which is full twenty-nine times its own weight, by the force of one pole, the key having no permanent vertue before.

I never saw this out-done by the loadstone itself, as it is commonly used; but what a good one used as I did the steel would do I know not.

*Magnetism
acquired by
iron standing
long in the
same position.
By Mr. Ant.
Leeuwen-
hoek, n. 371.
p. 74. Apr.
&c. 1722.*

II. 4. THE iron cross, which is supposed to have stood upon the steeple of the new church in Delft about two hundred years, having been lately taken down to be repaired, I was informed by a foreign gentleman, that a piece of iron by standing long in one situation would acquire a magnetic quality. Upon which I desired a workman to procure me a piece of the cross, who accordingly brought me one about a span long, and $\frac{1}{4}$ inch thick; which I applied both to a working needle and the needle of the compass, but without any effect upon one or the other.

Some time after the same workman brought me some other pieces, looking like rusty iron, which he had broken off from the bottom of the cross, where it had been fastened by four cross pieces bound down with iron to an erect piece of timber nine inches square, and covered with lead in such a manner that no wet could get to it. This rusty iron would take up several needles hanging by one another, and appeared to have a stronger magnetic vertue than two loadstones which I had then in the house; and was so hard that no file would touch it.

*Observations
of the varia-
tion at Lon-
don in 1722
and 1723. By
Mr. G. Gra-
ham. n. 383.
p. 96. May,
&c. 1724.*

II. 1. THE figure of the three needles with which the experiments were made was prismatic; their lengths were nearly 12,2 inches; their ends which pointed to the divisions being filed to an edge, which made a fineline perpendicular to the horizon. The caps of two were of crystal, the other of glass; they were well polished on the inside, in that part which touched the pin they moved upon. The box was brass, and of a breadth sufficient to admit of 20° on each side the middle line, and covered with a piece of ground glass. The circular arches at the ends were raised so much above the bottom of the box as to have their upper surfaces, upon which the divisions were cut, lie in the same plane with the needle, and at such a distance from each other that the needle might play freely between them. A few of the degrees at the north end were divided into six equal parts, each division being $10'$. It was easy by the help of a convex glass to determine the pointing of the needle to less than a quarter of these divisions, or to about $2'$ of a degree. The pin upon which the needle moved was of steel hardened, and ground to a fine point; and by a spring placed in the box the needle might be raised from off the point and let down again at pleasure, without removing the glass or disturbing the box. By this means both the sharpness of the point and polish of the cap were better preserved from injury, when there was occasion to remove the box. A small piece of brass was made to

slide

slide upon that end of the needle which pointed to the south, for readily bringing it to an horizontal position; for according to the different strength of the touch, the north end of the needle will dip more or less. The bottom plate of brass was a little broader and longer than the box, and its edges made lines exactly parallel to the middle line of the divisions; and for the greater security of placing the box in a right situation, there was a brass ruler of thirty inches long, having its edges even and parallel, except part of the edge that was applied to the side of the box which was a little filed away on the middle, that the side of the box near its ends only might touch the ruler. By this contrivance the two points of contact were as far asunder as the length of the box would admit of, and the other edge of the ruler making a longer line than the side of the box, afforded a better direction for giving it the same situation.

For determining the quantity of the variation I got a meridian line stretched upon the top of the house, between the rails of the leads which were above fifteen foot asunder, and the line was a little more than thirty-nine inches above the leads. As this line was fastned to two pieces of brass that were fixed in the rails, and was above fifteen foot long, no sensible error could arise in putting it up at any time. The compass-box was placed upon a wooden-stool with three feet, that had nothing of iron about it, and its top set level by a plumb-rule. But finding that in the open air the wind gave some disturbance, I put up another line after the same manner in a room two pair of stairs high; this line was about the same length with the other, and thirty-nine inches above the floor. Sometime after I put up a third line of the same length in the room over this. By the method made use of in fixing these lines they could not differ above $2'$ of a degree from the meridian or from one another. Before I had made any trials, I imagined no other difference would arise than what might be occasioned by the friction of the needle upon the point it was to move upon, and having found that considerable in all the needles that I had taken notice of, I took more than ordinary care to provide against it, and succeeded beyond my expectation. For I have several times observed all the three needles return so exactly to the same place, that I could not perceive the least difference; as likewise all three to agree very nearly about the same time, when they have been placed in the same box immediately one after another, the box remaining unmoved. The first needle I made was a little above three tenths of an inch broad, about .06 in thickness, and weighed about an ounce Troy, the cap of crystal. After some trials with this needle it was made narrower, not to exceed half a tenth of an inch, and it then weighed five penny-weight and five grains. The second needle was at first about three tenths of an inch broad, and .04 thick, the cap of glass; and after several trials it was made so much narrower that its breadth was

a little less than its thickness, and it weighed two penny weight and five grains. The third was nearly of the same dimensions with the second, and weighed two penny weight and three grains. When the two first needles were made narrower, care was taken that the files made use of for filing the north ends touched not the south ends, and after they were made lighter I tried them both before they were fresh touched upon the stone, and found no sensible difference in their direction. The reason of making the two first needles so heavy, was to try whether they would return more constantly to the same situation than the lighter ones. But notwithstanding each of them would settle very exactly in the same place, for a great number of trials made immediately one after another, yet I found them at different times to differ considerably from their former directions.

This occasioned my making them narrower, fearing their breadth had been some way concerned in this irregularity. But after the alteration I found the same thing happened, though I could find nothing of it to proceed from any friction upon the point. This made me prefer the lighter needles, as less apt to injure the point they moved upon, and as exact in returning to the same situation. After many trials I found all the needles I made use of would not only vary in their direction upon different days, but frequently at different times of the same day; and this difference would sometimes amount to upwards of half a degree in the same day, sometimes in a few hours. And this alteration I observed, whether the needles were drawn aside immediately before the observation, or suffered to remain undisturbed. For I have left the box standing for several days together without ever disturbing the needle, only have taken notice what it pointed at and the time of the day, and I could sometimes perceive in a few minutes a very sensible alteration. But whether it stood near its greatest or least variation, or whether I drew the needle to one side with a key, a few degrees or a greater number, it would constantly return to the same place it stood at immediately before. Sometimes I have taken the needle out of the box and put it in again, and this I have repeated several times in the space of an hour. At other times I have taken down the box from off the stool and put it up again, but have found no alteration in its direction; so that I found it of no consequence whether the needle was drawn aside or let alone, the shaking of the floor by walking upon it or the trembling of the house by the coaches in the street was sufficient to overcome the small friction upon the point. When I made the observations I was very careful to have no keys nor iron about me that could affect the needle.

The box was placed in the room above six foot from the nearest wall, and above thirteen foot from the grate in the chimney, and no iron could at any time be brought near it without my knowledge. Yet, after all, I am not satisfied that it was out of the reach of iron, and

and that the variation shewn by it is the true quantity ; but I am very sure there was no change of circumstances in the room that could affect it, for if there were any such materials in the wall or floor, their distances and situations continued the same. But for a farther confirmation of this irregularity, I put one of the needles into a wooden box with a few degrees divided as the other, and placed it at the same meridian line, at the distance of three foot and an half from the other, and found both needles nearly agreed in their alterations. The needles were all touched by that excellent loadstone presented to the society by the Lord Paisley. It may not be improper to take notice that the needles were not touched upon the naked stone, but with its armour on, generally upon that part of the capping nearest the poles ; but I could not find a difference in the direction by touching upon another part. I may add, that when I have observed the needle encreasing or decreasing in its variation, I have very frequently with a key drawn it the contrary way several degrees, and then letting it return very gently, 'till it has been within a degree or less of the place it stood at immediately before, I have there stopt it for some time by holding the key at a proper distance ; and withdrawing my hand gradually, have tried to make it stand short of its former place, but could never succeed. By this method and several others made use of, I am well assured these changes in the direction are owing to some other cause than the friction of the needle upon the pin ; but what that cause is I cannot say, for it seems not to depend either upon heat or cold, a dry or moist air, clear or cloudy; windy or calm weather, or the height of the barometer. The only thing that has any appearance of regularity is, that the variation has been generally greatest, for the same day, between the hours of twelve and four in the afternoon, and the least about six or seven in the evening.

March 8, 1722. This day a piece of brass was fixed to a wooden box, and a few degrees were divided into 10' each, as in the brass box, to try if both needles would be alike affected in the several alterations. This wooden box was placed at the same meridian line, and about the distance of $3\frac{1}{2}$ foot from the other.

March

The first column shews the variation of the needle in the brass box. The second column shews the variation of that in the wooden box. The third column shews the time by the clock, when the observations were made.

174 Variation at London in 1722 and 1723. PART II.

Needle 2=5.	March 8. h.	Needle 5=5	Needle 2=5.	March 9.	Needle 5=5.
14°=30'—	3=00'	14°=25'+	14°=10'	9 ^h =30'	14°=10'
14=20	3=15	14=20	14=10 +	10=00	14=10 +
14=15 +	4=00	14=10	14=10	10=15	14=10
14=20	4=15	14=15	14=10 +	10=30	14=10 +
14=25	5=00	14=20	14=15	11=00	14=15 —
14=25	5=30	14=20	14=00	8=15	14=00
14=15	5=45	14=10	14=00	11=50	14=00
14=00	5=57	14—			
14—	6=8	13=55			
13=50	6=15	13=40			
14=20	6=38	14=15 +			
14+	6=48	14=00			
14=00	6=54	14—			
14=5	7=5	14+			
14=10	7=15	14=5			
14+	12=00	14+			

Needle 2=5.	March 10.	Needle 5=5.	March 30, the needle 2=5 which was in the brafs box was this day put into the wooden box, and a new needle put into the brafs box, weight 2=3.
14°=10' +	10 ^h =00'	14°=10'	No remarkable change happened to either needle 'till Apr. 5.
14=15	11=00	14=10 +	
14=15	12=00	14=10 +	
14=15 +	12=45	14=10 +	
14=15 +	1=00	14=10 +	
14=15 +	1=30	14=10 +	
14=15 +	1=45	14=10 +	
14=15 +	2=00	14=10 +	
14=15	3=30	14=10	
14=15 +	4=00	14=10 +	
14=15 —	5=30	14=10 —	
14=10	6=00	14=5	
14=00	6=15	14=00	
14—	6=30	14—	
14+	7=30	14+	
14=5	7=45	14+	
14+	12=00	14+	

Needle 2=3.	Apr. 5.	Needle 2=5.
14°=5'	9 ^h =00'	14°+00'
14=10	1=30	14=5
14=10 —	5=30	14+
14—	8=15	14—
13=50 +	8=37	13=45
13=55 +	9=45	13=45 +
14—	10=25	13=50
14=00	10=45	13=55
14+	11=00	14=00

The first column shews the variation of the needle in the brafs box. The third the variation of that in the wooden box. The second column shews the time, by the clock, when the observations were made.

April

CHAP. IV. Variation at London in 1722 and 1723. 175

April 15, 1723.

14° = 30' —	9h = 00'
14 = 30 —	10 = 00
14 = 30	11 = 30
14 = 30 +	12 = 30
14 = 30 +	1 = 30
14 = 30	3 = 30
14 = 30	4 = 10
14 = 30 —	5 = 30
14 = 20	6 = 18
14 +	7 = 8
14 = 00	7 = 50
14 = 00	8 = 15
14 = 15 +	8 = 20
14 = 15 +	8 = 40
14 = 15 +	12 = 15
14 = 00	12 = 27
14 = 00	12 = 32
14 = 00	12 = 35
14 = 00	12 = 43

Wind at S. W.

April 16.

14° = 30' —	9h = 30
14 = 30	11 = 00
14 = 30	12 = 00
14 = 30 +	1 = 10
14 = 30 +	1 = 40
14 = 30	2 = 45
14 = 30	5 = 00
14 = 30 —	6 = 00
14 = 25	6 = 20
14 = 20	6 = 30
14 = 15	6 = 35
14 = 10	6 = 40
14 = 10 —	6 = 45

14° = 5'	6h = 49'
14 = 00	6 = 57
14 = 00	7 = 10
14 +	7 = 20
14 = 5 +	7 = 30
14 = 10	7 = 45
14 = 15	8 = 00
14 = 15 +	8 = 20
14 = 20 —	8 = 30
14 = 25 +	9 = 00
14 = 25	12 = 12
14 = 25	12 = 21

Day warm, cloudy in the morning, evening clear.

April 19.

14° = 30' —	8h = 35'
14 = 30 —	9 = 00
14 = 30 —	1 = 30
14 = 30 —	2 = 00
14 = 30	3 = 30
14 = 30	4 = 00
14 = 20	5 = 00
14 = 25	5 = 38
14 = 25 +	5 = 45
14 = 30 —	6 = 00
14 = 30 —	6 = 45
14 = 25	7 = 00
14 = 20 —	8 = 00
14 = 20	9 = 00
14 = 20 +	10 = 00
14 = 25	11 = 00
14 = 25	11 = 15

Day warm, wind at east, some thunder in the afternoon.

May 2.

May 2.

$14^{\circ} = 25'$	$9^h = 30'$
$14 = 30 +$	$10 = 30$
$14 = 35 -$	$11 = 30$
$14 = 35 +$	$1 = 00$
$14 = 35 +$	$1 = 52$
$14 = 40 +$	$2 = 30$
$14 = 20$	$3 = 30$
$14 = 25$	$3 = 45$
$14 = 30 -$	$4 = 00$
$14 = 25 +$	$6 = 45$
$14 = 20$	$7 = 00$
$14 = 30 -$	$7 = 35$
$14 = 20 +$	$12 = 50$

Day cold, wind at east.

May 3.

$14^{\circ} = 10'$	$9^h = 30'$
$14 = 15$	$11 = 10$
$14 = 15 +$	$12 = 40$
$14 = 15 +$	$2 = 20$
$14 = 10 -$	$5 = 20$
$14 = 10$	$6 = 5$
$14 = 10$	$6 = 45$
$14 = 10 -$	$7 = 5$
$14 = 5$	$7 = 15$
$14 +$	$7 = 30$
$14 = 00$	$7 = 42$
$14 +$	$8 = 00$
$14 +$	$9 = 38$

 $14^{\circ} +$
 $14 +$ $10^h = 15'$
 $11 = 00$

Day cold, wind easterly.

May 4.

$14^{\circ} = 5'$	$9^h = 15'$
$14 = 5$	$9 = 30$
$14 = 10 +$	$1 = 35$
$14 = 10 +$	$3 = 17$
$14 = 10 +$	$3 = 50$
$14 = 10$	$4 = 55$
$14 = 10$	$6 = 00$
$14 = 00$	$8 = 15$
$14 +$	$1 = 00$

Windy at east.

May 5.

$14^{\circ} = 10' +$	$9^h = 30'$
$14 = 15$	$10 = 45$
$14 = 15 +$	$12 = 30$
$14 = 20$	$1 = 57$
$14 = 20$	$2 = 45$
$14 = 20$	$3 = 25$
$14 = 20 -$	$4 = 35$
$14 = 15 +$	$5 = 30$
$14 = 15 +$	$6 = 10$
$14 = 15 -$	$12 = 7$

Day clear, wind at east.

All these observations are of the lightest of the three needles, the compass box remaining unmoved the whole time. From Feb. 6, 1722, to the 10th of May following, I made about a thousand observations in the same place; and the greatest variation westward, was $14^{\circ} = 45'$, and the least $13^{\circ} = 50'$. It was seldom less than $14'$, or greater than $14 = 35'$.

II. 2. HAVING

CHAP. IV. *Variation in the South-Sea in 1709-10.* 177

II. 2. HAVING lately had the opportunity of perusing Capt. Woodsin the Rogers's original journal, who in 1709-10, in 8 weeks time traversed the great South-Sea or Pacific Ocean, I was highly pleased to find the care he had taken to set down the variations of the magnetical compass in his passage from the south cape of California to the island of Guana, one of the Ladrões, being about seven hours or 105 degrees of longitude. This might have been long since expected from Capt. Dampier, who had three times made the tour of the world, and thrice gone this very same track.

South-sea in 1726. By Capt. Woods Rogers. Communicated with remarks by Dr. Halley. n. 368. p. 173. May, &c. 1721

It were to be wished that the French, who have had frequent opportunities to do it, would bestow upon us an account of the variations they have lately found in their voyages from Peru and Chili to China; and that the Spaniards would tell us how the needle varies at this time in the north part of that great sea, through which they return from the Manilla's to New Spain. With these helps, having three points in each curve, we might be enabled with a tolerable certainty to compleat the system of the magnetic variations, which I was forced to leave unfinished, as to this part of the ocean, in my general chart thereof, for want of the observations requisite.

In the following account of Capt. Rogers's observations the first column gives the correct latitude of the place; the second the longitude from London, as estimated by reckoning; and the third the variation.

January 1709-10.	Lat. N. cor- rect. every day.	Long. West from London.	Variation Easterly.
00 12	22 16	114 09	03 00
00 01	21 18	114 42	02 50
02 00	20 24	115 15	02 50
02 15	19 25	115 45	02 50
00 00	18 56	116 24	02 45
01 30	18 00	117 06	02 45
01 30	17 11	117 30	02 15
00 30	16 32	118 05	02 00
02 20	15 44	118 54	01 50
01 00	15 00	120 15	01 30
01 00	14 49	122 05	01 10
00 00	14 36	124 25	00 50
02 30	14 24	126 45	00 40
02 25	14 14	129 05	00 45
04 20	13 50	131 23	00 50
	13 29	132 58	01 00
	13 29	134 41	01 10
	13 22	136 48	01 15
30	13 27	139 21	01 25
	13 32	142 07	01 30
Feb. 1	13 32	144 37	01 40
	13 36	147 32	01 50

178 Variation in the South-Sea in 1709-10. PART II.

1709-10.	Lat. North	Long. West	Variation
correct. daily	from London.	Easterly.	
Feb. 3.	13 26	150 18	02 00
	13 26	153 02	02 10
5	13 26	155 19	02 25
	13 26	157 43	02 30
	13 25	160 31	02 50
	13 41	163 00	03 00
	13 41	165 18	03 20
10	13 44	167 26	03 30
	13 36	169 56	03 45
	13 33	172 27	04 00
	13 36	175 00	04 30
	13 32	177 21	05 20
15	13 40	179 28	06 30
	13 47	181 24	07 00
	13 54	183 22	07 30
	13 52	185 37	09 00
	13 40	187 42	10 15
20	13 28	189 49	11 00
	13 21	191 30	11 30
	13 12	193 25	12 00
	13 07	194 37	11 50
25	13 10	195 51	11 00
	13 03	197 51	10 00
	13 00	199 03	09 50
	12 57	200 16	09 30
	12 54	202 20	09 00
March 1	12 58	204 12	08 40
	13 04	206 06	08 20
	13 05	207 33	08 00
	13 05	209 04	07 50
5	13 02	211 54	07 30
	13 07	212 42	07 10
	13 07	214 07	07 00
	13 03	215 28	06 50
	13 08	217 11	06 30
10	13 16	218 27	05 40
Island of Guana in sight.			

By this it appears that at about 250 or 300 leagues west from the south-head of California, the east variation diminishes to about $\frac{1}{2}$ of a degree; that for 1300 leagues from thence, the same easterly variation gradually encreases to about 12 degrees, where it becomes greatest. And that at the isle of Guam, five hundred leagues still more westerly, it is again decreased to 5 degrees 40 minutes.

As far as this single instance can direct us, I am inclinable to think that in all that space of sea which lies to the northwards of our track, between Japon and California, there reigns an easterly variation, which is still greater and greater as the north latitude encreases. But that to the southward of our track, and especially to the southward of the equinoctial, a westerly variation arises, of no great extent or quantity, but which is greatest about 1000 leagues west from the coast of Peru and Chili, about the same meridians where Capt. Rogers found the east variation smallest. This is agreeable to the Theory of the variation I laid down in N^o 148 of the Phil. Trans. † Vol. II: P. II. Ch. iv, § viii. about 40 years since; and I then expressly mentioned, in my seventh remark on the observations there cited, that there was undoubtedly such a tract of west variation in the southern parts of the South-Sea, it being the necessary consequence of the site of the four magnetical poles there supposed, though at that time I wanted experiments to prove it.

II. 3. JUNE 1, 1720, being at anchor near Revell in the latitude of $58^{\circ} 58'$ north, at sun-set

The magnetical amplitude west - - - $64^{\circ} 30'$ north.

The true amplitude west - - - - - $49 \quad 37$ north;

The variation north - - - - - $14 \quad 53$ west.

July 23, at the isle Gottsand in the latitude of $58^{\circ} 21'$ north, at sun-set,

The magnetical amplitude west - - $49^{\circ} 50'$ north.

The true amplitude west - - - - - $35 \quad 00$ north.

The variation north - - - - - $14 \quad 50$ west.

The difference of longitude of these two places by Dead Reck. is $1^{\circ} 50'$.

Oct. the 24th at Bornholme, in the latitude of $56^{\circ} 00'$, at sun rising,

The magnetical amplitude east - - - $43^{\circ} 15'$ south.

The true amplitude east - - - - - $28 \quad 31$ south.

The variation north - - - - - $14 \quad 44$ west.

Z 2

II. 4. Month

Vol. II:
P. II. Ch. iv,
§ viii.

... in the
Baltic in 1720
By Mr. W.
Sanderson.
n. 366. p. 120.
Sep. &c. 1720.

180 Variation in the Ethiopic ocean, in 1721. PART II.

... in the
Ethiopic ocean
in 1721. By
Capt. Corn-
wall. n. 371.
p. 35. June,
&c. 1722.

II. 4.

Month and Year.	Lat.	Mer. Diff. from S. Jago.	Long.	Var.
Aug. 1721.	24 9° 8' S	9° 23' W	9° 25' W	2° 13' E
	26 11 12 S	10 26 W	10 50 W	4 30 E
	27 11 34 S	11 48 W	11 41 W	4 29 E
	28 12 32 S	11 31 W	11 43 W	4 27 E
	31 15 46 S	10 53 W	11 6 W	6 10 E
Sept.	2 16 26 S	8 25 W	8 30 W	7 16 E
	5 18 45 S	9 31 W	9 39 W	6 17 E
	6 19 47 S	9 10 W	10 0 W	8 6 E
	17 28 43 S	1 7 W	1 9 E	5 53 E
	22 31 33 S	3 41 E	3 56 E	4 10 E
	27 33 30 S	11 29 E	12 57 E	0 11 W
	30 32 40 S	19 6 E	12 1 E	3 0 W
Oct.	1 32 53 S	21 18 E	24 59 E	5 41 W
	3 32 30 S	25 33 E	30 0 E	7 47 W
	5 32 28 S	30 37 E	35 52 E	8 44 W
	6 31 22 S	31 40 E	37 7 E	10 57 W
	7 31 11 S	32 4 E	37 47 E	11 20 W
	13 26° 17' S	35° 35' E	41° 41' E	14° 30' W
	19 19 41 S			12 22 W
	21 17 4 S			14 29 W
	25 13 56 S			14 48 W
Nov.	4 10 57 S			13 11 W
	7 8 19 S			15 14 W
	29 5 0 S	in Cabenda-bay.		14 33 W
From Cabenda to London, Mer. Diff. from thence.				
Dec.	9 3° 25' S	11° 38' W	11° 43 W	11° 32' W
	14 3 30 S	21 18 W	21 24 W	
	20 0 30 S	30 41 W	30 46 W	1 5 W
Jan.	1 10 50 N	39 8 W	39 16 W	1 1 E
1722.	6 17 15 N	43 21 W	43 29 W	1 41 E

On the coast
of Africa.

... at Vera
Cruz, in 1726
and 1727. By
Mr. J. Harris.
n. 401. p. 389.
Jan. &c. 1728

II. 5. In the years 1726, and 1727, I observed at Vera Cruz the magnetic variation several times, and found it to be about $2\frac{1}{2}$ degrees easterly.

We also observed the variation several times on our voyage thither from England with a good azimuth compass, but I always found that the best observations we could make, when compared together, differed so much that we could not depend upon them to much less than three or four degrees, or sometimes half a point of the compass. II.

CHAP. IV. Variation between London and Hudfon's bay. 181

II. 6. A new and exact Table of the variation of the compass in several latitudes and longitudes, collected out of observations taken in four voyages from London to Hudfon's bay, in N. America, between the years 1721 and 1725.

... between
London and
Hudfon's bay.
By Capt. Chr.
Middleton.
n. 393. p. 73.
March, &c.
1726.

Lat.	Long.	Vari.	Long.	Vari.	Long.	Vari.
D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.
50 00	12 00	14 00	18 45	17 00	25 30	20 00
51 00	12 00	14 15	18 45	17 15	25 30	20 15
52 00	12 00	14 30	18 45	17 30	25 30	20 30
53 00	12 00	14 45	18 45	17 45	25 30	20 45
54 00	12 00	15 00	18 45	18 00	25 30	21 00
55 00	12 00	15 15	18 45	18 15	25 30	21 15
56 00	12 00	15 30	18 45	18 30	25 30	21 30
57 00	12 00	15 45	18 45	18 45	25 30	21 45
58 00	12 00	16 00	18 45	19 00	25 30	22 00
59 00	12 00	16 15	18 45	19 15	25 30	22 15
50 00	14 15	15 00	21 00	18 00	27 45	21 00
51 00	14 15	15 15	21 00	18 15	27 45	21 15
52 00	14 15	15 30	21 00	18 30	27 45	21 30
53 00	14 15	15 45	21 00	18 45	27 45	21 45
54 00	14 15	16 00	21 00	19 00	27 45	22 00
55 00	14 15	16 15	21 00	19 15	27 45	22 15
56 00	14 15	16 30	21 00	19 30	27 45	22 30
57 00	14 15	16 45	21 00	19 45	27 45	22 45
58 00	14 15	17 00	21 00	20 00	27 45	23 00
59 00	14 15	17 15	21 00	20 15	27 45	23 15
50 00	16 30	16 00	23 15	19 00	30 00	22 00
51 00	16 30	16 15	23 15	19 15	30 00	22 15
52 00	16 30	16 30	23 15	19 30	30 00	22 30
53 00	16 30	16 45	23 15	19 45	30 00	22 45
54 00	16 30	17 00	23 15	20 00	30 00	23 00
55 00	16 30	17 15	23 15	20 15	30 00	23 15
56 00	16 30	17 30	23 15	20 30	30 00	23 30
57 00	16 30	17 45	23 15	20 45	30 00	23 45
58 00	16 30	18 00	23 15	21 00	30 00	24 00
59 00	16 30	18 15	23 15	21 15	30 00	24 15

Lat.

182 Variation between London and Hudson's bay. PART II.

Lat.			Long.			Vari.			Lat.			Long.			Vari.		
D.	M.		D.	M.		D.	M.		D.	M.		D.	M.		D.	M.	
50	00		32	15		23	00		50	00		41	15		27	00	
51	00		32	15		23	15		51	00		41	15		27	15	
52	00		32	15		23	30		52	00		41	15		27	30	
53	00		32	15		23	45		53	00		41	15		27	45	
54	00		32	15		24	00		54	00		41	15		28	00	
55	00		32	15		24	15		55	00		41	15		28	15	
56	00		32	15		24	30		56	00		41	15		28	30	
57	00		32	15		24	45		57	00		41	15		28	45	
58	00		32	15		25	00		58	00		41	15		29	00	
59	00		32	15		25	15		50	00		43	30		28	00	
50	00		34	30		24	00		51	00		43	30		28	15	
51	00		34	30		24	15		52	00		43	30		28	30	
52	00		34	30		24	30		53	00		43	30		28	45	
53	00		34	30		24	45		54	00		43	30		29	00	
54	00		34	30		25	00		55	00		43	30		29	15	
55	00		34	30		25	15		56	00		43	30		29	30	
56	00		34	30		25	30		57	00		43	30		29	45	
57	00		34	30		25	45		58	00		43	30		30	00	
58	00		34	30		26	00		59	00		43	30		30	15	
59	00		34	30		26	15		51	00		46	00		29	00	
50	00		36	45		25	00		52	00		46	00		29	15	
51	00		36	45		25	15		53	00		46	00		29	30	
52	00		36	45		25	30		54	00		46	00		29	45	
53	00		36	45		25	45		55	00		46	00		30	00	
54	00		36	45		26	00		56	00		46	00		30	15	
55	00		36	45		26	15		57	00		46	00		30	30	
56	00		36	45		26	30		58	00		46	00		30	45	
57	00		36	45		26	45		59	00		46	00		31	00	
58	00		36	45		27	00		52	00		48	30		30	00	
59	00		36	45		27	15		53	00		48	30		30	15	
50	00		39	00		26	00		54	00		48	30		30	30	
51	00		39	00		26	15		55	00		48	30		30	45	
52	00		39	00		26	30		56	00		48	30		31	00	
53	00		39	00		26	45		57	00		48	30		31	15	
54	00		39	00		27	00		58	00		48	30		31	30	
55	00		39	00		27	15		59	00		48	30		31	45	
56	00		39	00		27	30		53	00		51	00		31	00	
57	00		39	00		27	45		54	00		51	00		31	15	
58	00		39	00		28	00		55	00		51	00		31	30	
59	00		39	00		28	15		56	00		51	00		31	45	

CHAP. IV. *Variation between London and Hudson's bay.* 183

Lat.			Long.			Vari.			Lat.			Long.			Vari.		
D. M.			D. M.			D. M.			D. M.			D. M.			D. M.		
57	00		51	00		32	00		60	00		69	00		41	00	
58	00		51	00		32	15		61	00		69	00		41	40	
59	00		51	00		32	30		62	00		69	00		42	20	
60	00		51	00		32	45		60	00		72	00		40	00	
54	00		54	00		32	00		61	00		72	00		42	00	
55	00		54	00		32	15		61	40		72	00		42	40	
56	00		54	00		32	30		62	00		78	00		43	00	
57	00		54	00		32	45		63	00		78	00		44	00	
58	00		54	00		33	00		63	05		78	00		46	00	
59	00		54	00		33	15		61	00		75	00		38	00	
60	00		54	00		33	30		62	00		75	00		43	00	
61	00		54	00		33	45		62	05		75	00		45	00	
54	00		57	00		33	00		63	00		81	00		43	00	
55	00		57	00		33	15		64	00		81	00		46	00	
56	00		57	00		33	30		62	00		82	00		39	00	
57	00		57	00		33	45		63	00		82	00		44	00	
58	00		57	00		34	00		61	00		84	00		33	45	
59	00		57	00		34	30		62	00		84	00		40	00	
60	00		57	00		35	00		63	00		84	00		42	00	
61	00		57	00		35	30		60	00		86	00		30	00	
55	00		60	00		34	00		61	00		86	00		33	00	
56	00		60	00		34	30		62	00		86	00		35	00	
57	00		60	00		35	00		59	00		88	00		28	00	
58	00		60	00		35	30		60	00		88	00		28	40	
59	00		60	00		36	00		61	00		88	00		29	20	
60	00		60	00		36	30		57	00		90	00		24	00	
61	00		60	00		37	00		58	00		90	00		24	30	
57	00		63	00		35	00		59	00		90	00		25	00	
58	00		63	00		35	30		57	00		94	00		23	00	
59	00		63	00		36	00		58	00		95	00		22	30	
60	00		63	00		36	30		59	00		95	00		21	00	
61	00		63	00		37	00										
62	00		63	00		37	30										
59	00		66	00		37	00										
60	00		66	00		37	40										
61	00		66	00		38	20										
62	00		66	00		39	00										
63	00		66	00		39	40										

From long. 68 degrees to 81. is in Hudson's straits, where is the greatest variation, and the compass will hardly traverse.

II. 7. A

.... continued
by the same.
Communicat-
ed by Mr. B.
Robins.
n. 413. p. 71.
Mar. & C. 1751

II. 7. A new and exact Table of the variation of the compass in several latitudes and longitudes, collected out of observations taken between the years 1721 and 1729 inclusive in nine voyages to Hudson's bay in N. America.

Obf. means By Observation. Ac. By Account.

The longitude is reckoned from the meridian of London.

Lat.	Lon.	Vari.		Lat.	Lon.	Vari.		Lat.	Lon.	Vari.	
D.	D.	D.		D.	D.	D.		D.	D.	D.	
50	2 E.	12		55	16	18	Ac.	55	22	20	
49 $\frac{1}{2}$	0	12		56	ditto	18		56	ditto	20	
50	2 W.	13	Obf.	57	ditto	19		57	ditto	20	
50	4	13	ditto	58	ditto	19	Obf.	58	ditto	21	Obf.
50	6	13	ditto					59	ditto	21	
51	8	14	ditto	50	18	17	Obf.				
51	14	14	ditto	51	ditto	17		50	24	20	Ac.
52	12	15	Ac.	52	ditto	17		51	ditto	20	
53	12	dit.	ditto	53	ditto	17		52	ditto	20	
54	12	dit.	ditto	54	ditto	18		53	ditto	21	Obf.
55	12	16	ditto	55	ditto	18	Ac.	54	ditto	21	
56	12	16	Obf.	56	ditto	18		55	ditto	21	Ac.
57	12	17	ditto	57	ditto	19		56	ditto	21	
58	12	17	ditto	58	ditto	19	Obf.	57	ditto	21	Obf.
59	12	18	ditto	59	ditto	19		58	ditto	22	
								59	ditto	22	
50	14	14	Obf.	50	20	18	Ac.				
51	ditto	14		51	ditto	18		50	26	21	Obf.
52	ditto	15		52	ditto	18	Obf.	51	ditto	21	
53	ditto	15	Ac.	53	ditto	19		52	ditto	21	Ac.
54	ditto	16	Obf.	54	ditto	19		53	ditto	21	
55	ditto	16	Obf.	55	ditto	19		54	ditto	22	Obf.
56	ditto	17	Obf.	56	ditto	19	Ac.	55	ditto	22	
57	ditto	17	Obf.	57	ditto	19		56	ditto	22	Ac.
58	ditto	18	Obf.	58	ditto	20		57	ditto	23	Obf.
59	ditto	18	Ac.	59	ditto	21	Obf.	58	ditto	23	
								59	ditto	23	
50	16	15	Obf.	50	22	19	Obf.				
51	ditto	15	Obf.	51	ditto	19	Ac.	50	28	22	Ac.
52	ditto	16	Ac.	52	ditto	19		51	ditto	22	
53	ditto	16		53	ditto	20	Obf.	52	ditto	22	
54	ditto	17	Obf.	54	ditto	20	Ac.	53	ditto	23	Obf.

Lat.

Lat.	Lon.	Vari.		Lat.	Lon.	Vari.		Lat.	Lon.	Var.	
D.	D.	D.		D.	D.	D.		D.	D.	D.	
54	28	23		53	38	28	Obf.	57	46	33	Obf.
55	ditto	23	Ac.	54	ditto	28		58	ditto	33	
56	ditto	23		55	ditto	28	Ac.	59	ditto	33	
57	ditto	24	Obf.	56	ditto	28					
58	ditto	24		57	ditto	29	Obf.	56	48	32	Obf.
59	ditto	24		58	ditto	29		57	ditto	32	
				59	ditto	30	Obf.	58	ditto	32	
50	30	23	Ac.					59	ditto	34	
51	ditto	23		50	40	28	Ac.	60	ditto	34	
52	ditto	23		51	ditto	28	Obf.	61	ditto	34	
53	ditto	24	Obf.	52	ditto	28					
54	ditto	24	Ac.	53	ditto	29		57	50	33	Obf.
55	ditto	24		54	ditto	29	Ac.	58	ditto	33	
56	ditto	24		55	ditto	29		59	ditto	33	
57	ditto	25	Obf.	56	ditto	29		60	ditto	34	
58	ditto	25		57	ditto	30	Obf.	61	ditto	35	
59	ditto	25	Ac.	58	ditto	30					
				59	ditto	30		58	52	34	Obf.
50	32	24	Ac.					59	ditto	34	
51	ditto	24		51	42	29	Obf.	60	ditto	34	
52	ditto	24	Obf.	52	ditto	29		61	ditto	35	
53	ditto	24		53	ditto	30		62	ditto	35	
54	ditto	25		54	ditto	30					
55	ditto	25	Ac.	55	ditto	30	Ac.	58	54	34	Obf.
56	ditto	25		56	ditto	30	Obf.	59	ditto	35	
57	ditto	26	Obf.	57	ditto	31		60	ditto	36	
58	ditto	26	Ac.	58	ditto	31		61	ditto	36	
59	ditto	26	Obf.	59	ditto	31		62	ditto	36	
50	34	25	Obf.	52	44	30	Obf.	58	56	36	Obf.
51	ditto	25	Ac.	53	ditto	31		59	ditto	36	
52	ditto	25		54	ditto	31	Ac.	60	ditto	36	
53	ditto	25		55	ditto	31		61	ditto	37	
54	ditto	26	Obf.	56	ditto	31		62	ditto	37	
55	ditto	26	Obf.	57	ditto	32	Obf.				
57	ditto	26		58	ditto	32		58	58	36	Obf.
58	ditto	27	Ac.	59	ditto	32	Ac.	59	ditto	37	
59	ditto	27						60	ditto	37	
				53	46	31	Ac.	61	ditto	37	
50	38	27		54	ditto	32	Obf.	62	ditto	38	
51	ditto	27	Obf.	55	ditto	32		63	ditto	38	
52	ditto	27	Ac.	56	ditto	32	Ac.				

Lat.	Lon.	Vari.		Lat.	Lon.	Vari.		Lat.	Lon.	Vari.	
D.	D.	D.		D.	D.	D.		D.	D.	D.	
58	60	37	Obs.	61	72	42	Obs.	54	84	24	Obs.
59	ditto	38		62	ditto	43		55	ditto	25	
60	ditto	38		63	ditto	48		56	ditto	26	
62	ditto	38		62	74	41		57	ditto	27	
63	ditto	39		63	ditto	48		58	ditto	27	
58	62	38	Obs.	62	76	41		59	ditto	28	
59	ditto	39		63	ditto	47		60	ditto	29	
60	ditto	39		64	ditto	49		61	ditto	30	
61	ditto	39		62	78	40		62	ditto	40	
62	ditto	40		63	ditto	42		55	86	22	
59	64	39	Obs.	64	ditto	49		56	ditto	23	
60	ditto	39		63	80	40		57	ditto	24	
61	ditto	39		64	ditto	49		58	ditto	25	
62	ditto	40		60	82	38	Obs.	59	ditto	26	
60	66	40	Obs.	61	ditto	39		60	ditto	27	
61	ditto	41		62	ditto	40		56	88	22	
62	ditto	43		63	ditto	42		57	ditto	23	
59	68	40		64	ditto	44		58	ditto	24	
60	ditto	43		50	84	19		59	ditto	25	
61	ditto	44		51	ditto	20		60	ditto	26	
62	ditto	47		51	ditto	21		57	90	21	
60	70	43		52	ditto	22		58	ditto	22	
61	ditto	44		53	ditto	23		59	ditto	23	
62	ditto	47						60	ditto	24	

Hudson's freights.

In Hudson's bay.

In Hudson's bay.

An unusual agitation in the needle. By Capt. Walt. Hoxton. n. 417. p. 53. Jan. & c. 1731

III. Sept. 2, 1724, a little after noon, being in latitude $41^{\circ} 10' N$. longitude from cape Henry in Virginia about $28^{\circ} 00' E$. the weather fair, a moderate gale and smooth sea, my mate told me the compass traversed so much that he could not steer by it: whereupon I tried it in several parts of the ship and found what he said to be true. I ordered all my compasses to be brought up and placed in different parts of the ship, and the most remote from iron, but to my great surprise found them all in the same condition; so that we could not steer by any of them. Then I new touched some of them with a loadstone, and lest that should affect them, sent it out to the end of the bowsprit; but I did not perceive that the new touching was of any service, for they all continued traversing very swiftly for about an hour after I came on the deck, and then on a sudden every one of them

them stood as well as usual. During the whole time the ship had very little motion.

IV. ABOUT the time I was observing the variation of the horizontal needle, I made likewise some experiments with the dipping needle, to try if the dip and vibrations were constant and regular. The needle I made for this purpose was 12 inches and one tenth long, half an inch broad in the middle, but not above one tenth near the ends; the ends themselves being filed to fine edges; and in thickness it was about one third of a tenth. The ends of the axis upon which the needle turned were very smooth, and not bigger than was necessary for the support of the needle, which weighed nine pennyweights twenty one grains, or about half an ounce Troy. The ends of the axis were placed upon the edges of two thin plates of steel, that were hard, well polished, and parallel to the horizon, that the needle when vibrating might roll and not slide upon the edges of the plates, to avoid the friction they would have been subject to by moving in holes. A brass semicircle was provided, and from the lowest point graduated each way, and a few of the degrees about that part of it which answered to the dip were divided into six equal parts. By the help of screws the semicircle could be brought to a due situation; and by two spirit levels placed at right angles to each other any change of situation was easily perceived, and by the screws it could be readily restored to its former position; all was enclosed in glass to secure the needle from being disturbed by the motion of the air. I must here take notice of the great difficulty there is in poising the needle so exactly before it is touched with the loadstone, as to take any position indifferently: for when it is pretty near the truth it is extremely troublesome to place it at rest in the position desired, in order to try which way it is inclined to move. It cannot be done in the open air, the least motion whereof will disturb the needle; and when it is shut up it is no easy matter to settle it in the place intended. And that there will be a sensible difference of the dip upon shifting the sides of the needle, whatever pains be taken to prevent it, I am fully satisfied from the following experiments.

Observations of the dipping needle at London 1723. By Mr. G. Graham. n. 389. p. 332. July, &c. 1725.

Exper. 1.] March 20, 1723, I touched both sides of that end of the needle which I designed to point south upon the north-pole of a small terrella; after which I caused it to vibrate in an arch of ten degrees, and counted the time by a pendulum clock shewing seconds, 'till the needle had performed fifty vibrations.

It performed the first 25 vibrations in - - - 2' 58"

The next 25 vibrations in - - - 2 27

The 50 in - - - 5 25

Which gives for each vibration at a medium - - 6, 5

The needle dipped - - - 73° 15'

A a 2

Exper.]

Observations of the dipping needle. PART II.

Exper. 2.] I shifted the needle so that the side which before respected the east was now turned west, and causing it to vibrate in the same arch as before it performed

The first 25 vibrations in - - - - - 2' 49"
 The next 25 in - - - - - 2 39

The 50 vibrations in - - - - - 5 28
 That is, each vibration in - - - - - 6, 56

The dip - - - - - $73^{\circ} 50'$

Exper. 3.] I now touched the same end of the needle a second time on both sides upon the same stone, and suffering it to vibrate as before

It performed 25 vibrations in - - - - - 2' 49"
 That is, one vibration in - - - - - 6, 76
 The dip - - - - - $73^{\circ} 20'$

Exper. 4.] The needle was now shifted and stood as in the second experiment.

It performed 25 vibrations in - - - - - 2' 41"
 That is, one vibration in - - - - - 6, 44
 The dip - - - - - $73^{\circ} 45'$

Exper. 5.] The same end of the needle being now touched twice on each side with the loadstone presented by the Lord Paisley to the Royal Society, in its armour,

It performed the first 25 vibrations in - - - - - 1' 58"
 The next 25 in - - - - - 1 46

The 50 vibrations in - - - - - 3 44
 That is, each vibration in - - - - - 4, 48
 The dip - - - - - $73^{\circ} 55'$

Exper. 6.] The needle being turned and standing as in the second and fourth experiments it performed

The first 25 vibrations in - - - - - 2' 00"
 The next 25 in - - - - - 1 57

The 50 vibrations in - - - - - 3 57
 That is, each vibration in - - - - - 4, 74
 The dip - - - - - $74^{\circ} 10'$

Exper. 7.] I now touched the needle at both ends with the same stone with which it was touched in the fifth experiment, after which it performed

The first 25 vibrations in - - - - - 1' 35"
 The next 25 in - - - - - 1 34

The 50 in - - - - - 3 9
 That is, each vibration in - - - - - 3, 78
 The

The dip	- - - - -	74° 20'
The dip repeated with the needle taken off and replaced	74 20+	
Exper. 8.] Upon shifting the needle it performed		
The first 25 vibrations in	- - - - -	1' 33"
The next 25 in	- - - - -	1 34
The 50 in	- - - - -	3 7
The dip	- - - - -	74° 25'
The dip repeated	- - - - -	74 30—

The needle had the same side to the east in the first, third, fifth, and seventh experiments; and had that side turned westward in the second, fourth, sixth, and eighth; and I began to count the vibrations when I observed it to vibrate just 10 degrees, as near as I could guess. All these experiments were made with sufficient care in every particular, excepting the quantity of the dip, which requires the divisions of the semicircle to be very equal, and the 90th degree to be perpendicularly under the axis of the needle; this last I found was a little faulty, the dip being in reality greater than the semicircle shewed it. After I had rectified this error, and new touched the needle upon that part of the armour to which iron is applied when it is to be lifted by the stone, it performed the same number of vibrations in less time than in any of the former trials. I now determined to observe for some space of time both the dip and vibrations, without fresh touching the needle. The observations follow, by which it appears there is a very considerable difference both in the quantity of the dip and in the quickness of the vibrations.

In all these experiments the needle was placed so as to vibrate exactly in the plane of the magnetic meridian; and sufficiently distant from all iron that could affect it, as far as I could perceive, 'till I had occasion to put up a very large iron rod in the room above it, which immediately altered the dip of the needle, and thereby put an end to these trials.

Dip

1723.		Dip.	Time of the day.			Dip.	Time of the day.
Mar.	29.	75°=00' at 10 ^h =00'		Apr.	11	74°=35'+	10 ^h =00' a.m.
		74=53	4=15		13	74=40—	
	30	74=55+	1=00		14	74=40—	10=45
		74=50—	4=00			74=40—	11=15
	31	74=50—	10=00			74=35	5=10
		74=50—	12=30			74=35	8=17
		74=50—	2=15		15	74=35	9=10 a. m.
Apr.	1	74=25	6=45		16	74=35	11=00
		74=25—	7=15			74=30+	8=45
		74=20+	9=00		17	74=45	12=25
	2	74=20+	7=30 a.m.		18	74=40+	9=15
		74=20+	7=30 p.m.			74=45	5=00
	3	74=20+	9=30		19	74=45	9=00 a. m.
		74=20+	12=30		20	74=45	
		74=50	4=15		21	74=50	10=30
	4	74=55+	10=00		23	74=50	12=00
		74=50+	11=15		26	74=50+	2=30
		74=40	12=45		27	74=55	
		74=35	7=30		28	75=00	1=00 p. m.
	5	74=40	9=15			75=00	3=15
		74=40	1=45			74=58	5=15
		74=40+	5=30		30	74=40	3=15
		74=30+	8=15		May 1	74=45	1=30
	6	74=35	10=00		2	74=45	12=00
		74=35	12=00			74=45+	1=00
	7	74=35+	10=20			74=40+	3=50
		74=35+	12=30	The weight of the dipping needle 9pt. 21gr. Troy.			
		74=35	4=00				
		74=35	6=30				
	8	74=40—	12=15				
		74=40—	3=30				
	9	74=40—	10=00				
		74=40—	4=15				
	10	74=40—	10=00				
		74=30+	8=00				

N. B. The mark + signifies something more than is here set down, and — signifies something less, but the difference could scarce amount to more than two minutes.

The weight of the dipping
needle 9pt. 21gr. Troy.

N. B. The mark + signifies
something more than is here
set down, and — signifies
something less, but the dif-
ference could scarce amount
to more than two minutes.

Experi-

Experiments of the vibrations of the dipping needle, beginning with an arch of 10 degrees, with the times in which 100 vibrations were performed.

1723

April 1. about 7^h = 15' afternoon.

First 50 in 3' = 2'

Last 50 in 2 = 45

The 100 in 5 = 47. dip 74° = 25' —

April 2. in the evening.

First 50 in 3 = 3

Last 50 in 2 = 43

The 100 in 5 = 46. dip 74 = 20 +

April 3. about 4 in the afternoon.

First 50 in 2 = 52

Last 50 in 2 = 39

The 100 in 5 = 31. dip 74 = 50

Repeated about an hour after.

First 50 in 2 = 53

Last 50 in 2 = 35

The 100 in 5 = 28. dip 74 = 50 +

April 4. about 11 = 15 in the morn.

First 50 in 2 = 54

Last 50 in 2 = 30

The 100 in 5 = 24. dip 74 = 50 +

April 28. about 5 = 15 afternoon.

First 50 in 2 = 48

Last 50 in 2 = 16

The 100 in 5 = 4. dip 74 = 58

Repeated

First 50 in 2 = 47

Last 50 in 2 = 16

The 100 in 5 = 3. dip. 74 = 58

May 20.

First 50 in 3' = 11"

Last 50 in 3 = 1

The 100 in 6 = 12

Repeated, the needle being new touched.

First 50 in 2 = 38

Last 50 in 2 = 23

The 100 in 5 = 1. dip 74 = 35

Repeated again about an hour after.

First 50 in 2 = 38

Last 50 in 2 = 20

The 100 in 4 = 58. dip 74 = 30 +

May 21. about noon.

First 50 in 2 = 41

Last 50 in 2 = 28

The 100 in 5 = 9. dip 74 = 30

May 23. about 12 = 45

First 50 in 2 = 40

Last 50 in 2 = 27

The 100 in 5 = 7. dip 74 = 40

May 25. about 3 = 30.

First 50 in 2 = 41

Last 50 in 2 = 30

The 100 in 5 = 11. dip 74 = 40 +

May 27. about 6 = 30 afternoon.

First 50 in 2 = 41

Last 50 in 2 = 28

The 100 in 5 = 9. dip 74 = 50

V. An account of a book omitted.

n. 412. p. 245.

An account of a treatise entitled, Calculations and Tables relating to the attractive virtue of loadstones. By the Right Hon. the Lord Paisley. Anno 1729.

CHAP. V.

Botany.

*A method of
discovering
the virtues of
plants by their
external struc-
ture. By Dr.
Pat. Blair.
n. 364. p. 30.
Jan. &c. 1720*

I CAN never enough admire the judiciousness and sagacity of the ancients, who without any of those means made use of by the moderns have handed down to us such an account of the virtues of those plants which are more particularly used in physic, that all the endeavours of their inquisitive successors have never been able to outdo them. It must have been a long tract of experience which enabled Dioscorides and Theophrastus to collect such a catalogue of the virtues of plants, that scarce any thing has since been added to it. The royal academy at Paris has been at great pains to find out the virtues of plants by the chymical analysis and several other experiments, of which we have the abstracts in Tournefort's *Histoire des plantes aux environs de Paris*, and Tauvry his *Traité des médicaments*: but these endeavours only serve to confirm what the ancients advanced, without any new discovery. For Tournefort, after having made the experiments with the tournesol and blue paper and given an exact account of the several active chymical principles which are observed in such and such a plant, usually concludes, "Therefore 'tis not surprising if it has such virtues"; which is nothing but giving a reason why the ancients believed they were good for such distempers.

The means by which our forefathers discovered the virtues of plants and their use in the several diseases, as they were the most simple so they are most assisting at this very time. It seems they narrowly considered their *facies externa*, and thus concluded; if such a plant partake of such virtues, such another so very like it must be endowed with the same; v. g. apium and fœniculum have the same manner of flowering; both produce their seed after the same manner; their roots are both alike, being long, white, streight, carnos, &c. Therefore since long experience shews that such a plant has such virtues, such another like it must have the same. Thus we find apium, fœniculum, petroselinum, all joined together, and prescribed as the opening roots in the dispensatory.

This induced the expert Dr. Herman to lay down these general maxims: *Quæcunque flore & semine conveniunt easdem possident virtutes, and Omnia semina striata sunt carminativa.* The late ingenious

ous Mr. J. Petiver, a few years ago obliged us with a discourse upon this subject, printed in the Phil. Transf. N. 255, p. 289, * in which he observes, that the *plantæ umbelliferæ*, *galeatæ*, *verticillatæ*, *tetrapetalæ*, *filiquosæ*, and *filiculosæ*, for the generality, have a tendency to the same virtue and use. This was the occasion of some intercourse betwixt him and me, in 2 or 3 letters printed in my miscellaneous observations, wherein he observes that the *plantæ flore stamineo*, which he calls blink flowers; such as hops, nettles, docks, sorrels, betes, blites, spinage, oraches, bonus henricus, or english mercury, and kali minus album, are all good sallads, raw or boiled. Also the *leguminosæ* or pea-kind; such as pease, beans, phaseoli, are good nutritive food for men; and the tares, trefoils, medicæ, loti, and saintfoins, are good pabulum or fodder for beasts. To these he adds the *frumentacæ* or *cereales*; as the wheat, rye, and oats, in Europe, and the maiz, millet, panic, and sorgum, in the Indies, make good bread; and that from barley and rice we have good fermented and spirituous liquors. He further observes that the iris or flag-kind in foreign parts afford us prevalent drugs of no mean virtue and use; such as ginger, galingal, turmeric, zedoary, casumuniar, and cardamoms. The laurus or bay-kind has some noble attendants of the same tribe with itself; such as cinnamon, cassia lignea, malabathrum, folium indicum, and the camphire tree.

In answer to his I added that all the *pappescentes* & *lactescentes*, such as the sonchus, dens leonis, hieracium, lactuca, cichoreum, endivia, tragopogon, and scorzonera, have the same virtues and serve for the same uses both in the kitchen and shops. All the *asperifoliæ*, such as borago and buglossum, are those which are called coolers in a more or less intense degree; for some are astringent, as consolida, others narcotic, as cynoglossum. All the *galeatæ* and *labiatæ* for the most part consist of subtile particles, and are therefore cephalics; as lavender, rosmarinus, majorana, &c. mentha, pulegium, melissa, hysterics. Attenuaters and inciders, as salvia, horminum, &c. A fourth sort somewhat astringent, as bugula, lamium, &c. So that by having an idea of the virtues of a majorana, mentha, salvia, lamium, we come to know the virtues of all their congeners. All the papavers are narcotic. The *esulæ* and *tithymali* are cathartic; though both these are lactescent, yet they differ from those which are pappescent also. All the malva's are chiefly emollient; the pentaphyllous kind astringent; as are also the plantains. The corymbiferous kind are either stomachics, hysterics, or vermifuges. The gentian bitters, stomachics, hysterics and febrifuges. The pomiferæ scandentes, as cucumbers, melons, &c. are coolers; but some are cathartic, as cucumis sylvestris, and colocynthis. The convolvuli, as mechoacanna, &c. are purgative; to which jalappa, by flower and fruit, is near of kin. Digitalis and gratiola are emetic and purgative. The squamous and bulbous roots are emollient and more or less acrid. Thus allium, cepa,

porrum, unboiled, are hot, diuretic and lithontriptic. All the seda are coolers.

Thus at the first view, without knowing the characteristics so nicely as botanists do, but only exactly observing the facies externa of the plant, when the virtue of one species is known the virtues of all the congeners may be guessed at if not fully determined.

The next simple method of the ancients to discover the virtues of plants seems to have been the taste and smell. Thus apium and petroselinum have a like taste, therefore they are to be prescribed together. The seeds of fœniculum and anisum have much of the same taste and smell, and therefore both of them must be carminative, &c. They had likewise recourse to the temperament and qualities, such as hot and dry, cold and moist, in the first, second, third, and fourth degrees. But since the taste is not always the same in one person, and different persons have different sensations; that, as being too subject to the different tempers and imaginations of people, is deservedly exploded.

I have lately composed a compendious scheme of all the plants used in physic; in which, that I might render it less liable to objection and not seem to introduce any innovation in the distribution, I have not so strictly observed the making their characteristic notes and virtues agree, but have distributed them according to their operations.

The first distribution is by joining together all those which are prescribed under one title in the shops; such as the opening roots, emollient and capillary herbs, cordial flowers, hot and cold, greater and lesser seeds. In this I have not kept to the dispensatory catalogue, but have added several congeners, that I might give a specimen of what is proposed concerning the virtues and characters. Thus I have added cuminum and meum to fœniculum; laurus alexandrina, and hippoglossum to ruscus; alcea to malva and althea; bonus henricus, atriplex, &c. to beta, under the title of oleraceous emollients; lingua cervina, polypodium, &c. to the capillary herbs; and so on in the cordial flowers, and hot and cold seeds.

I have, secondly, distributed the plants into such as are altering and evacuating. The altering are divided into those that consist of gross, and such as are said to consist of tenuious and subtile particles. Those consisting of gross particles are astringent: such as prevent abortion and ruptures, stoppers of the fluxus menstruus immodicus, fluor albus, diarrhœa, dysentery; good in burnings, bruises, cancers, spitting of blood. Gross medicines are narcotics, vulnerary, good for scrophulous tumors, squinancy, refrigerators.

Plants consisting of subtile particles are aperient; such are all opthalmics, arthritics, nephritics, lithontriptics, diuretics, hydropics. They are also pectoral, anti-apoplectic, paralytic, hysterick, hypochondriac,

driac, provokers of birth, febrifuges, scorbutics, stomachics, vermifuges.

The evacuating medicines are emetic, or laxative and purgative. The nutritive medicines are the plantæ cereales and leguminosæ.

It is here to be noted that I have not inserted any plant in this table but such as are natives of Britain, or such as are cultivated in British gardens; and to render it still the more useful I have added such particular parts as are used in the shops; viz. the root, herbs, leaves, tops, flowers, fruit, nuts, bark and wood.

Having thus reduced within a small compass the most considerable virtues of plants, both general and specific, and shewn the most easy, simple, and natural method of discovering them, I would not be understood as if I were averse to other methods of finding them out. On the contrary, I could heartily recommend one hitherto much neglected, and which I am convinced would be of great use if accurately gone about; and that is their infusion in different liquors, in order to find out the proper menstruum for extracting their more useful parts.

Every physician is sensible that there are several simples, and those specific too, which given in substance are of great efficacy; whereas if their contexture is dissolved their parts can never be so reunited as to produce the same effect. Thus cortex peruvianus is never so effectual as when given in powder. That there are others which will communicate their useful particles, when infused, to one liquor and not to another; and that the same substance will impregnate two liquors diversely, according to the different menstrooms. Mr. Lemery advises to infuse opium in water and spirit of wine separately; and afterwards to mix both infusions together in order to make the laudanum or extract; wisely considering that the water will be impregnated by the more soluble saline particles, whereas the spirit will only imbibe the more resinous; for water is the proper menstruum for a saline substance which will not dissolve in spirit of wine; this rather hardening and preserving it from being dissolved either by air or water. Thus the most convenient way to preserve the volatile salt of animals, is to keep it among brandy; and every one knows that water immediately dissolves sugar, which brandy will not do. Therefore fenna will impart its purgative quality to water or ale, having its saline particles more disengaged; but the purgative virtue of jallap consisting in its refine requires wine or brandy for the menstruum or dissolvent.

Therefore, in my opinion, a most proper means to find out the virtues of plants is to have recourse to the proper menstrooms. A simple may be infused in rain water, snow water, or pure fountain water; if its texture is loose and it abound with saline particles, those pure elements will be impregnated by it; but if the texture be more compact, firm and solid, if its particles are more fixed, mineral waters; or by the addition of a proportional quantity of the fixed salt of a plant

a proper menstruum may be prepared. And next to giving the biters in substance, such as wormwood, gentian, and camomile flowers, that is the most convenient way of administering them: not but their tincture extracted by brandy or wine may do very well; but since they abound very much with a fixed salt, a great deal of their virtue may be communicated to a less spirituous liquor when a more spirituous will not extract it. The proper means to know which menstruum will extract the more useful parts of any simple, or rather suspend its more solid particles, is to use the hydrostatical balance; when having weighed the menstruum before infusion, and after the materies has been infused for some time, it will soon be observed by the augmentation of the weight how far the menstruum is impregnated and which is the most proper dissolvent. The properest method of adhibiting the fixed simples, if not in substance, is by decoction, infusion, or tincture: (it is called infusion when the menstruum is either water, ale, or wine; but a tincture when brandy is employed;) and the best way to obtain the useful particles of volatile, tenuious, or subtile substances is by distillation. These may indeed be proper ingredients for an infusion or tincture; but there are a great many fixed substances as improper for distillation as the volatile are improper for extracts.

The anatomical preparation of vegetables. By Albert Seba. Communicated by Sir Hans Sloane, Bart. n. 416. p. 441. Nov. &c. 1730.

II. I. TAKE leaves of vegetables that are somewhat substantial and tough and have woody fibres; as for instance, leaves of orange trees, of lemon, laurel, of cherry, apricock, peach, plumb, apple and pear trees, of poplar, oak, &c. Many sorts of leaves have no such woody fibres or veins; as for instance, vine and lime-tree leaves.

Those of the first sort are to be gathered in June or July, when they are most perfect, not touched by worms and caterpillars. They are to be put into an earthen pot or a wide glass vessel, with a good deal of rain-water poured over them, and afterwards left in the open air, uncovered and exposed to the warmth of the sun. The water must always stand above the leaves, and if it evaporates so as to leave them dry, fresh water must be poured on. Thus the leaves begin to putrify; some sorts will be rotten in a month, others hold out two months and longer. When the two external membranes begin to separate, and the green substance of the leaf to grow liquid, then it is time to perform the operation. The leaf is to be put into a white flat earthen plate or dish filled with clear water; then being gently squeezed with the finger, the membranes begin to open in the extremities, and the green substance comes out. Take the membranes on both sides dexterously off with the finger, which must be most carefully done in the middle of the leaf near the stalk: if there is once an opening the rest follows easily. The skeleton that remains between is afterwards washed in clear water and kept in a book.

The

The method with relation to fruit, as apples, pears, plumbs, cherries, peaches and the like, is as follows. The finest and largest pears that are soft and not stony are most proper for this sort of anatomy. First, they are to be nicely pared without squeezing them, and care taken not to hurt the stalk or the crown. This done, put them into a pot of rain or fresh spring-water; cover it, and make them boil gently 'till they grow thoroughly soft; then take them out and put them into a vessel of cold water: the pear which is to be anatomized, is to be put into a dish filled with cold water; hold it by the stalk with one hand, and with one finger and the thumb of the other hand rub the pulp of the pear gently off, beginning near the stalk and rubbing equally towards the crown, and you will easily see in the water how the pulp separates from the fibres, which being most tender towards the extremities, it is there the greatest care is to be taken. No instrument is of any use in this operation, except at last of all a penknife to separate the pulp sticking to the core. In order to see how the operation advances, you may fling away the muddy water from time to time and pour on clean: all being separated, the skeleton is to be preserved in spirits of wine rectified. The same process is to be observed with relation to apples, plumbs, peaches and the like. Turnips and other roots that have woody fibres or ribs must be boiled without paring, 'till they grow soft and the pulp comes off. Not only many sorts of roots, but also the barks of several trees may be reduced after this method into skeletons, presenting rare and curious views of vegetables.

II. 2. ALBERT SEBA having communicated to the society his method of dissecting vegetables I separated the pulpous from the fibrous parts of several leaves according to his directions; when examining them by glasses and in water I found that each fibre was naturally separated into two distinct fibres by a thin stratum of the pulpous substance; and that this separation was continued through all the fibres and stem of the leaf, so as to form two distinct planes of similar network.

Of the veins and arteries of leaves. By Dr. Frank Nicholls. n 414. p. 371. May 22. 1730.

Though this duplication of the vessels in leaves seems to point out an analogy between them and the veins and arteries of animals, yet I see no probable means of guessing which are the arterial and which the venal fibres.

That I might illustrate this matter as it appeared to me, I have prepared two leaves the one fig. 63, of an apple, the other fig. 64, of a cherry; in which as well the separation of the fibres and stem, as the pulpous substance by which they are naturally separated, are very obvious.

II. 3. SEEING some reddish boards and enquiring what they were, I understood they were bought of the India company, and came from

Of the vessels in wood. By Mr. Anthony the Leeuwen-

hoek. n. 367. p. 134. Jan, 8th, 1725.

the island of Amboina. I procured a piece of it and some of the chips, in order to observe the vessels therein; and cutting the wood through all manner of ways, I found that in one place it appeared whitish, at a small distance red, and in another place blackish. Upon cutting it transversely, I saw the orifices of the ascending vessels which ran along the length of the wood, and which appeared of such a size in the microscope that one would have judged a pea might pass through them. Where the wood looked reddish, I found these great vessels filled with a substance of a fine red colour, so that I imagined they carried a red sap into the horizontal vessels, which were so very numerous and so thick together that they caused the wood to appear of the same colour with the red substance which was contained in them. I afterwards cut off some very thin slices transversely, and putting them into a China cup I poured hot water upon them and suffered them to lie in it for some time; then viewing them with a microscope I observed that the red substance was extracted by the water, and no red colour was now to be found in any of the vessels.

What seemed strangest to me in this wood, was that cutting through it lengthways, as I frequently did, I observed it to be of a fine red colour for one hair's breadth, and a hair's breadth farther it appeared white; and the ascending vessels seemed to be smaller where the wood was red than where it was white: which narrowness of the red vessels I judged to proceed from the sap contained in them.

On viewing the ascending vessels in oak I found some others which entered into their sides, and appeared like so many small round holes, especially where the horizontal vessels lay, which I judged to be united to the ascending vessels by means of those small orifices, and thereby to discharge part of their sap into them. Taking a small twig of an oak, which in seven years was grown to about the thickness of one's finger, I cut it through according to the length both of the ascending and horizontal vessels, which last I saw lying in great numbers very close together, and proceeding directly from the pith of the twig.

In fir the ascending vessels consist of so very fine and thin a substance, that they exhibit a most delightful spectacle in the microscope. In them I imagined that I saw some globules, with a small opening in their middle, which seemed to be of a closer and denser substance than the rest of the wood. But I afterwards found myself mistaken, and that these supposed globules were nothing else but the orifices, whereby the ascending and horizontal vessels were united together, and through which the sap was carried from the one end to the other.

Of the pores of box-leaves, and the downy of spraches and quince. By the same.

n. 369. p. 231. Sept. & c. 1721.

II. 4. NUPER cogitationem meam converti ad frondes arborum nostratum, tacitusque meditabar num & illæ forsitan osculis sint instructæ; cum igitur in area mea duas haberem arbusculas buxi, folium ex iis unum decerpsi & in partes divulsam ope microscopij contemplatus sum.

sum. Tum vero partes illas per quas transpiratio fit clarissime visu distinxi. Adhæc complures percepi exiguissimos hiatus qui lucem transmittabant: quos tamen commodius majorique numero percepi cum partes prædicti folij aliquanto essent sicciores. Præterea quædam buxi foliola, partim adhuc virentia partim exsiccata, mihi adferenda curavi ut illorum texturam investigarem: quod eo successu feci, ut spiracula in iis clarius visu perceperim quam in ullis unquam fructibus ante percepissem. Ut autem multitudinem osculorum quæ in tali foliolo percepi velut oculis expositam haberem, folium buxum lineali imposui cupreo quod in varias partes distinctum erat: comperique longitudinem folij parem esse octonis partibus pollicis in decem partes distributi; folij vero latitudinem cum medietate pollicis, sive quinque decimis partibus exæquari. Jam vero ponamus tali foliolo figuram esse ovatam; adhæc latitudinem ejus atque longitudinem conjungamus: tum exsurget numerus 13, cujus dimidium sit $6\frac{1}{2}$. Dein ponamus idem foliolum, post illam latitudinis atque longitudinis conjunctionem, instar circuli esse rotundum; illiusque diametrum $6\frac{1}{2}$. decimis pollicis partibus ex æquo respondere. Exinde juxta foliolum ante dictum locavi pilum porcinum; quem microscopio contemplatus, judicavi duodecim buxi oscula, si sibi contigua jacerent, cum diametro pili porcini longitudine exæquari; sexaginta vero pilos porcinos judicabam magnitudinis esse pollicaris. Sequitur decimam quamque pollicis partem sex diametris pilorum porcinatorum longitudine parem esse; dimidiatam vero diametron folioli buxei cum $19\frac{1}{2}$ diametris pilorum porcinatorum exæquari. Quæ $19\frac{1}{2}$ diametri si duodecies, id est juxta numerum osculorum, multiplicentur, efficitur numerus 234, quam longitudinem dimidiatus folioli buxei circulus ex antedictis habet. Ut autem quid tali circulo contineatur supputemus, primo cum geometris statuendum est; quæ proportio est numeri 14 ad numerum 11, eandem proportionem esse inter numerum quadratum diametri cujusvis circuli & ea quæ circulo ipso continentur. Sequitur unam folij buxei superficiem oculis 172090 præditam esse. Cum autem altera superficies haud paucioribus instructa sit, tandem exsurget numerus osculorum 344180, quorum ope perspiratio & exhalatio fiat.

Cum lanuginem illam quæ mala persica convestit nupera æstate sine microscopio considerarem, frustula quædam mali persici ex cortice excisa ante microscopium collocavi. Tum vero judicabam floccos illos laneos multitudine pares esse oculis per cutem mali persici diffusis. Et quemadmodum oscula fructuum velut inter duo labiola patescere, nec plane rotunda sed aliquantulum oblonga esse, jam ante monui; sic flocci lanei ex oculis dictis efflorescentes non omnino rotundi sunt, sed nonnihil plani. Sed & complures in medio ruga quadam notatos esse videbam. Ut autem osculorum, unaque exhalantium humorum, qui aerem ingressi in particulas oblongas sed alias aliis longiores spissescunt, ingentem numerum oculis subjiciam; exiguum mali persici portionem

Fig. 65.

tionem delineari curavi. A B F G perpusillum est frustum mali et corticis perfici, B C D E F lanugo malo adhærescens. Magnitudinem dicti frustuli per iconem designati sic æstimare poteris: tres vultus mei pilos microscopio applicatos pictori, post iconis modo dictæ delineationem, intuendos exhibui. Cum deinde ejusdem iconis longitudinem A G in 16 partes distribuissem; rogavi quot latorum pilorum diametros in illa iconis longitudine contineri judicaret; qui ne octo quidem respondit. Quod si verum esse statuamus, quam incredibili floccorum lancorum multitudine necesse est malum persicum circumvestiri!

Fig. 66.

Cum postea mala sive pyra cydonia permaturuissent, quasdam etiam mali cydonij particulas ad microscopium applicavi; & lanuginem quæ ex malo cydonio exhalatur neque lanugini mali perfici copiâ cedit delineandam curavi; H I N O perparva est portio mali corticisque cydonij, I K L M N lanugo ex malis cydoniis exsudans. Quæ lanugo, licet in cydoniis longior quam in persicis, non tamen in illis erigitur sicut in istis; sed crispando sibi invicem implectitur.

Observations
on the seeds of
plants. By the
same. n. 368.
p. 200. May,
&c. 1721.

II. 5. I HAVE often observed the so called membranes in which the substance of meal or flower is enclosed, like little packets in cells or boxes, which is also the case of all kinds of beans, pease, wheat, barley and other grain. I at length, with astonishment, discovered very plainly that these membranes were full of an unspeakable number of little holes, through which in many places one might perceive the light. These holes we can suppose to be nothing else but little vessels that had been torn or cut off, and partly compose the membranes, partly serve for the production of the farina, of which there are an infinite number of particles in a pea or bean. I imagine that each of those mealy particles receives its increase by a little vessel proceeding from its cell, but imperceptible through its smallness. These vessels, of which the little cells or cases mostly consist, are more easy to be discovered in beans and pease than in any other sort of legumen or in grains; but in wheat the vessels are difficultly traced in the cells, and I was obliged to make very many observations and experiments before I could fully satisfy myself that I saw the torn or broken vessels; the reason of which is, that the little vessels, of which the cells or skins of the grains of wheat are composed, are exceeding thin and brittle. I have also found, upon observing the vessels of which the cells are composed, that several of the globules in wheat were broken to pieces in the operation, and that in one of those single globules there were other small globules enclosed. I have likewise observed that the membranes or little cells in barley, in which the globules of the meal are shut up and receive their increase, are thicker and stronger than those of wheat.

I took a large almond and cut off several thin slices from it, and dug out of them the substance that lay in the little cells, then viewing them

them as nicely as possible with a microscope I observed that the cells in which the oil of the said almond was for the most part contained, consisted of nothing but little vessels. I designed if it had been practicable to view the smaller sorts of seeds, in order to find out whether their little cells in which the farinaceous matter might lie were likewise composed of small vessels: but I changed my mind, believing that my endeavours therein would be ineffectual, by reason of the smallness of those little cells, and consequently of the vessels of which they were made up, though I do not question but what we discover in the great seeds is analogous to the structure of the small ones.

Now when I perceived that the before-mentioned little cells proceeded from the bark or skin which surrounds the kernel of the seed or grain, I was thinking that, as the mealy substance receives its encrease from the vessels in the little cells, and as the plant is formed between the cells while the seed lies in the earth, and as the little orifices in the skin of animals and fruits are formed to discharge their superfluous moisture, and shut in such a manner that no moisture or common air can enter: so on the contrary, the orifices of seeds are so formed that many of their little vessels admit moisture to pass inwards, and accordingly water is driven into them by the pressure of the air and causes the seed to swell; upon which, a warmth and fermentation succeeding in the seed it requires a greater space, and by the particular formation of the particles which lie in the cells, and which have derived their encrease from the cells, the mealy substance of which they consist is partly driven out of them into the body of the young plant, which by this means encreases so much in bulk that the root is now able to supply it with nourishment from the earth, at which time the seed is found to be diminished in its bigness.

III. 1. Mr. P. Miller writes me Nov. 11, 1721, that in pursuance of my advice he separated the male plants of the spinage from the female; the consequence was, that the seed swelled to the usual bigness, but did not grow when he sowed it. He examined the seed and found it wanted the punctum vitæ, which perhaps might have been the case with Mr. Geoffroy; but if not, the female embryos might have been impregnated another way, as he experimented with twelve tulips which he set by themselves about six or seven yards from any other, and as soon as they flowered took out the stamina so very carefully that he scattered none of the dust; about two days afterwards he saw bees working on tulips in a bed where he had not taken out the stamina, which came out loaded with the dust on their bodies and legs, and flew into the tulips out of which he had taken the stamina; when they came out he went and found they had left behind them sufficient to impregnate these flowers, which accordingly bore good ripe seed; this persuades him that the farina may be carried from place

*Observations
on the genera-
tion of plants.
By Dr. Pat.
Blair to Sir
Hans Sloane
Bar. n. 369.
p. 216. Sept.
&c. 1721.*

* Vid. Vol.
IV. P. II.
Ch. v. § iv.

to place by insects, and when they happen upon a flower whose uterus is capable to be impregnated by such a dust, it may be thus effected.

I am of opinion this will not suit with Mr. Morland's scheme *. For though we may suppose the stamina of every flower to be loaded with a due proportion of the farina, yet this accidental conveyance of it to a neighbouring flower may be less than is necessary rather than greater: in which case those embryos which had not received the determined particle into their bosom must be defective in bulk, or barren in growing; but here all were equally filled.

By another letter, Oct. 19, 1721, he informs me, that he bought a parcel of Savoy seeds of a neighbour, which he sowed and planted out the plants; but was surprized to see the production: for he had half of them red cabbages, some white cabbages, some favoys with red ribs, and some neither one sort nor other, but a mixture of all sorts together in one plant. He went to the gardener who shewed him that he was in the same condition, but did not know how it should come to pass, for he was sure he took special care in saving the seed. Being asked how and where he planted them for seed, he shewed him them under a south-west hedge, and told him that he planted first a dozen of white cabbages, then a dozen of favoys, and then a dozen of red. Mr. Millar immediately thought it came to pass by the effluvia of one sort impregnating the uterus of another; and it is common for our gardeners to plant white and red cabbages together for seed, and they are as often disappointed by having a degeneracy of both kinds, which they attribute to the soil, send to Holland for a fresh supply of seeds, and say our soil will not continue that sort good. He told them his opinion, but they laugh at him for it, and will not be turned out of their road, though they should have never so many experiments shewed them.

This is a most convincing argument for the effluvia; for did each grain of the farina enter the pistillum to its proper uterus this mongrel kind would never be produced. For if the individual plant be in each grain of the male farina, how can it be so far dismembered as that one part shall go to the making up of the ribs of red cabbage, and another to compose the rest of a favoy plant. Analogous to this is what I lately observed in a spaniel bitch, of so good a kind, that when she became proud care was taken to let her have good dogs. The litter she produced consisted of puppies some piebald, like one of the dogs that had lined her, of the same shape, colour and spots; others like another; and a third partaking of both, with spots from the bitch interspersed. This is a farther confirmation of what I have advanced, Essay 4, where page 310, I only assert, that several foetus's partake equally of male and female; but here two males concur with one female in the composition of a fourth body made up of all the three: and one seed produces a cabbage consisting of three different species,

species, which could never happen did these organized animalcula become a foetus, or the granules of the farina contain the folia seminalia of a plant. This methinks is sufficient to answer what Mr. Bradley has so strenuously contended for*. I could descant yet more upon this observation, and consider how far it may lead us into the infinite variations and stripes, not only in annual flowers, such as poppies, *consolida regalis*, and bottles, but also in perennial roots, such as auricula's, coullips, &c. of a lower size, which is hinted by Mr. Bradley; he having received that notion from the ingenious M. Du Bois, as I have been credibly informed; and in plants of a larger size, not of a bulbous but carnos root, such as columbines; where there is a vast variety: and in this plant it is most especially to be observed, that though the indigenous one, from which all the other seem only to be variations and not determinate species, be of a blue colour, consisting of ten alternate petala, viz. five corniculate, and five plain; yet into how many other kinds of flowers is it subdivided? such as pale yellow, with bluish red, purple, dark stripes very double, blue, blackish red, &c. Some with corniculate petala, and some only with plain, and how in single flowers it imitates all the colours we see in pigeons. I say it is worthy of consideration whether the farina may do this, since I do not understand there has been much art used in making these flowers break as tulips, or to cultivate a set of breeders; but that a richer soil may produce a double flower; and a suitable loam may produce the variety of colours; the farina from several flowers may occasion the stripes, and the stamina arising from the plain petala, rather than the cornicula pouring out the farina, may cause the flowers with the plain petala. So that were I to extend this to a great many other plants and had proper observations upon them, considerable improvements might be made in this doctrine of the sexes of plants. For after the flowers we come next to the variegation of the seed of some plants, particularly the phascoli, whose various spots and colours, and even the bigness too, may very much depend upon the effluvia from the farina when several kinds are sown together. For do but consider three plain colours, a white, red, and dark blue, and you may observe how many descendants and what a variety of spots may proceed from them. The lupines also in some measure may be brought in here, and I know not but that the *medica cochleata falcata lunata* may be multiplied in its variations after the same manner.

Mr. Miller being persuaded by an ingenious gardiner pulled off all the male-flowers of some melon plants as soon as they appeared; but instead of finding, as his friend informed him, that these flowers exhausted the nourishment from the fruit; he found that without these flowers none of the melons would grow. As this experiment is

* Works of Nature. p. 9. & seq.

a plain indication of the necessity of the farina so it confirms the use I have assigned to the leaves, viz. that by entering the capillaries of the leaves and returning, the nutritive particles may be more attenuated: so here, the petala of the male-flowers may serve for the same purpose; for by the largeness of the tubuli in these pomiferæ scandentes a gross viscid sap is received, which even the leaves themselves are not sufficient to attenuate so as to be fit for composing the more subtle part of the fruit: but it requires repeated circulation through the petala of the male-flowers to render it fit for such a purpose. Indeed the female flowers upon the top of the rudimentum fructus may in some measure serve this end. But as the male-flowers are, generally speaking, more numerous than the female, so their being removed must deprive the embryos of a very great assistance towards their being perfected: I may add that the orifices of the pedicles when the flowers are pulled off must lose so much of the sap that the whole plant must be impoverished, and rendered unable to bring forth its fruit; all this beside the want of the considerable supply of the farina fecundans.

I designed to have given a few thoughts concerning the variegation of leaves and flowers, being unwilling to admit of Mr. Bradley's sickness or weakness of the sap: but I shall reserve that to a more convenient opportunity, being at present intent upon making some farther improvement on the generation and nourishment of plants.

An observation on Indian corn. By P. Dudley, Esq. n. 385. p. 198. Oct. &c. 1724.

III. 2. INDIAN corn is of several colours, as blue, white, red, and yellow; if these sorts are planted by themselves, so that no other be near them, they will produce their own colour; but if you plant the blue corn in one row of hills, as we term them, and the white or yellow in the next row, they will mix and interchange colours; that is, some of the ears in the blue corn rows shall be white or yellow; and some again in the white or yellow rows shall be blue. Our hills of corn are generally about four foot asunder, and so continued in a streight line as far as the field will allow; but this mixing and interchanging of colours has been observed when the distance between the rows of hills has been several yards; and a worthy clergyman of this province assures me that he has observed it even at the distance of four or five rods; and that too where there was a broad ditch of water betwixt the hills. Some of our people, but especially the ab-origines impute this to the small fibres of the roots reaching to and communicating with one another; but this must certainly be a mistake, considering the great distance; for the smallest fibres of the roots of our Indian corn cannot extend above four or five foot, especially cross a canal of water. I am therefore of opinion that the principles of this wonderful copulation or mixing of colours are carried by the wind, when the corn is in the earing and while the milk is in the grain; for then the corn is in a sort of æstuation and emits a strong scent.

CHAP. V. *A change of colour in grapes and jessamine.* 205

scent. This is confirmed by an observation of a neighbour, that a close, high, broad fence, between two fields of corn of different colours, entirely prevented any mixture or alteration of colour in either of them.

IV. 1. ABOUT six years ago I planted a cutting of a vine, which bore excellent white muscadine grapes, against an eastern wall where it has the sun from its rising 'till half an hour after twelve. The soil is a stiff clay, but I improved it by mixing with it some of the foundation of an old brick-wall: in Jan. last was twelve months I pruned it, and its figure was like the letter T. At the time of year it shot at both hands about twenty two inches of a side before it came to a joint; that on the right was as big as the body of the tree, the other side was not half so thick, and the leaves on the right were as big again as those on the left-hand, and I think the largest that were ever seen. The right-hand bears a very large and good black grape, in great bunches; the left-hand very good white grapes: and whereas in all vines bearing black and blue grapes the leaves die red, these die white on the black side as well as on the other.

A change of colour in grapes. By Mr. Henry Cane, n. 366. p. 102. Sept. &c. 1720.

IV. 2. IN Apr. 1692, having a small plant of our common white jessamine no bigger than a tobacco-pipe I cut it off at two joints above the ground, and grafted it with a cutting of the yellow strip'd, which took and put forth a small weak shoot; in a month or five weeks after, perceiving that a blight had killed the graft and some part of the stock below, I cut it to the quick, which was near the joint next to the ground, designing to graft it again in the spring, but forgot it 'till the season was past. At length going that way I saw it had broke out at the next joint with several shoots of the yellow and green strip'd; and it had also made a strong shoot from the root of yellow and green strip'd: after a while I took it up with mold to the root, and put it into a pot where it flourished two or three years, and then for want of shifting the pot in time it was so matted to the bottom and sides that it died.

.... in jessamine. By the same. ibid. p. 103.

V. 1. THE berries of misselto have within their viscid pulp a kernel covered with a thin whitish skin; the inward substance whereof is deeply green, and harder than a pistacho nut's kernel. It is flattish and shaped sometimes like a heart, sometimes oblong; both are as truly seed as any plant can have. The latter sort put out but one germen; the former two, which prove two distinct plants. Sir J. Colebatch recommends the sowing this seed by inoculation: accordingly in Feb. 171⁸, I placed the berries within the bark of oak, ash, beech, pear, and apple-trees, by making several cuts and gashes in the upright sides of the trees; but the whole berries would not stay in any of them; and when I broke them the seed always slipped out to the edge of the cut, and there it stuck to the bark by means of the slimy substance where-

The propagation of misselto. By Mr. Edm. Barrell to Sir Hans Sloane Bar. n. 397. p. 215. Jan. &c. 1727.

with

with it is encompassed. I also stuck one seed on the bare bark without cutting it at all, which succeeded best, and being the heart-like shape gave me two plants. For about March 28, 1719, this, with two more on the apple-tree, and one on the pear-tree, began to shoot in this manner : the viscous matter having, as it dried, drawn the seed close to the bark, there began in March and April to spring out of the end of the seed next the eye of the berry a small deep green shoot like a little clasper of a vine. At first it rose upward, and then turning again swelled out somewhat bigger round the end ; yet leaving the very tip quite flat, forming, as it were, a foot to stand upon. This foot when it came to the bark, which was about May or June 1719, fixed itself thereon. Being thus fastened at both ends it made a little arch whose diameter was as long as the seed, or about $\frac{1}{3}$ of an inch. Thus it remained 'till about March or April 1720, and then the other end let go its hold, and raising itself upward put forth leaves and became the head of the plant : and the end which sprung out first and had taken footing in another place became the root. 'Tis indeed no uncommon thing for seeds of ever-greens to be two years before they spring out of the ground. But the change of the ends, first one of them shooting out and then the other, was what surprized me most at first ; yet I find nature is always uniform, and even in this strange plant acts in the same manner as in other vegetables ; carrying the sap first one way to form the root, and then turning the course of it back again to send out the upper parts of the plant. The strangest and most wonderful part is that the rooting end should first shoot into the open air, and then turn down to find a proper place to fix upon. This indeed seems to be the very thing that hath kept the world so long in ignorance about the growing of this seed. For by requiring a new smooth place of the bark whereon to fix the rooting part, it hath frustrated all attempts of sowing it in the usual way of other seeds. Theophrastus, about 2000 years ago, endeavoured to give a reason why this seed could not grow in the earth : but all that he or any one since hath said upon it is only to agree that in fact it doth not, and to wonder why so perfect a seed should not grow in the earth. However, he justly concluded from its having a seed that the plant must come from that seed : whereas latter times have been so fond of allowing chance a share in the productions of nature, that Scaliger hath not only experimentally confuted the common notion of misselto's being sown in the dung of the thrush ; but argueth also very strenuously against the possibility of this plant's growing from its seed. Even the Lord Bacon, Sir T. Brown, Lobel, and the inquisitive Ray, so late as 1673, do all give into it, that this plant hath a spontaneous and æquivocal, rather than a seminal and univocal generation. Scaliger's strongest objection is, *Quod ē ramis quibusdam exit viscus quo in loco nullis modis vel stercus consistere vel semen unquam potuerit hærere—*

hære — Nihilo enim commodius consistere quam in re proclivi globum. Lobel objects against it, because of the imperfection of the berry, Acinulo illo pallido pellucido. Mr. Ray's argument is, Viscus innatus etiam in pronâ ramorum parte. But if the thing had been well examined it would have appeared that this seed is of a substance equal to other kernels; and that the pulp wherewith it is surrounded is of such a clammy nature as to be sufficient to fix it on any bough, how moveable or upright soever. And doubtless the birds are, though not by their dung, sowers of this, as they are of many other seeds, which they carry away for food but often drop in places where they could otherwise never have come. As an instance of this I went lately to gather some misselto berries, and found a leaf with a seed sticking thereon; doubtless by a casual fall out of the bill of some bird, that had broken the berry as she was eating it. A dry string and a dry spot of the slime upon the leaf, shew how the seed was detained there. I have sown these seeds on near thirty sorts of trees and shrubs, yet never had above ten plants that held out the second year; so that we need not wonder at the ill success others have had in their trials. This is also the reason why I have made so few experiments about this plant. However, accident has furnished me with two or three, which somewhat further explain the nature of its growing. 1. One of my little plants sown in Apr. 1724, which was fixed at both ends in its arch-like form, had in Sept. 1724, the middle part broken off, the two ends keeping still fast to the tree; which shews how firmly they adhere while it is in that state; both of them continued green some time and then withered away. 2. One seed which grew on a pear-tree in 1718 was the next spring 1718 loosened from the tree at one end as the others were, yet never put out any leaves, but continued in the same state, neither bigger nor less, 'till it was broken off by chance in July 1726: this seems very strange. 3. My most thriving pair of plants of the year 1718, being about three inches in length, were on the 21st of May 1722 struck off by the falling of a rake-handle against them. They took away with them only the outmost thin skin of the tree, and I could see no signs of deeper rooting. But after some time I observed the bark swell a little; and Mar. 12, 1722, I perceived three or four little buds, and on the 18th another. They all bore leaves that summer; and now Feb. 1722, they are a cluster of boughs, of four or five joints in height, and bore berries this winter; whereas two others on the same tree, and which were also sown at the same time in 1718, and are six or seven joints in height, have not yet born any berries. The thriving of these plants so well again after they were broken off made me reflect on the Druids way of cutting misselto from the oak with a golden instrument; a metal not apt to take a good edge, and possibly the bluntness of the instrument might be a means to preserve a future growth of the same plant; which doubtless

less they, as well as we, found very rarely upon the oak. I might suggest some reasons for this scarcity from the nature of that bark; and I might observe many mistakes into which both modern and ancient writers run when they mention this plant. But I shall only mention this one observation, that there is almost every year on most mistletoe-bushes, a visible proof that the kernel hath a vegetative life or germinating principle in it: for when the berries hang on 'till May or June the seed will make its little shoot in the berry, as the kernels of lemons, and you may see it coming out at its eye.

A germinating principle visible in its berries. By the same to the same. n. 399. p. 306. July, &c. 1727.

V. 2. THE birds do not often permit the berries to remain so long; but as I have formerly observed this, so I have this year found old ripe berries and young green ones both on the same stalks, of which I have sent you a specimen: in the old ones may be seen, even through their skin, the little germen putting forth its head from the seed or kernel. I have likewise formerly had a suspicion that the plants of mistletoe are some male some female: and am now persuaded that it is so.

A difference of sex in it. By the same to the same. n. 405. p. 347. Nov. 1728.

V. 3. DR. HERMAN BOERHAVE, in the *Historia Plantarum*, said to be dictated by him, has already told the world of a difference of sex in mistletoe. But he mentions it in such a manner as makes me suspect that he only took his notion from Tournefort, and was not fully apprized of the true nature of these plants. "*Ovarium alio à flore loco natum*" seems to suppose both flower and ovary to be on the same plant, though in distinct places of it. I have, from my own sowing of the berries, four thriving plants of mistletoe growing on one tree in my garden. These being often in my view gave me the first apprehension of a difference of sex in this shrub. They were not of age to bear flower or fruit 'till 1726; when one of them bore a berry or two; and expecting that they should all do so the following year, I frequently examined them and found that two plants had berries and two had none. I then examined the mistletoe on other trees which have plants of above twenty years growth, and made the following observations.

Dr. Grew takes notice that many plants make a visible preparation in the former year for the flower and fruit of the next season. This is done by mistletoe. At the latter end of May the male plants put out little knobs at the joints and tops of their boughs, which at first are not very unlike the young green berries; but they soon appear evidently distinct from them, and being by the latter end of July grown as large as the berries are then not at all like them; spreading wider upwards, and having three, four, or five buds at the top of each knob. About June the female plant also makes a like preparation, putting out at the joints and tops of the boughs, knobs sharper and shorter than those of the male; with one, or two, but most commonly three buds or small points at the top of each. I call them buds, because in their season they

they open into flowers, both in the male and female plants; all the rest of the knob serving only for footstalks to the flowers in the one sort, and to both flower and fruit in the other. By the latter end of August the berries are grown much larger than the knobs on the male plants; and from thence 'till late in January there is little worth remark in either plant; only the berry grows somewhat bigger and becomes ripe, and the knobs on the male grow more and more yellow; so that one may at that time discern a male from a female plant at a considerable distance. By the 20th of Feb. misselto is in bloom, both male and female. The knobs of the male are open at the top with three, four, or five blossoms; which are very well described, though in short, in the above-mentioned *Historia Plantarum*. The female plant flowereth also now with a blossom, which Boerhave calls the ovarium, exactly like the male flower; save only that the whole female flower is not bigger than one leaf of the male. They both continue in full bloom 'till the middle of March, when the male blossoms begin to wither and drop off. And by the 20th of March the young berries begin to shew themselves, swelling forth one under each female blossom, which often adheres to the top of the berry and being carried up with it presently withers and soon falls off again; though some continued on 'till the 12th of May, when the berries were of the size of a great pin's head. This compleated the year's observation. And I think it is much to be wondered at that this plant, which hath been the admiration of all ages, should scarce ever find one observer so curious as to follow the changes of it through one whole year: for if this had been done with any accuracy, it must have been evident that one sort of misselto was quite different from the other; one sort bearing very small flowers with berries succeeding them, the other bearing much larger flowers not succeeded by any berries; the very footstalk of the male falling off with the flower; whereas the footstalk of the female becomes a footstalk to the berry. It is possible that this difference of sex in misselto may be of consequence in medicine: to those therefore who would make any experiments of the different virtues of these plants I offer this general observation: that there is no time of the year wherein the difference of the sexes is not very easy to be seen or known by the marks above-mentioned: and the meanest herb-woman will soon have skill enough to bring the sort they are ordered to procure; there being as great a plenty of the male plants as of the female.

VI. A friend of mine having caused some ashen pipes, that had brought water to his fountain for twelve years at least, to be taken up, they were left in an unpaved-yard where they rotted almost entirely: but in their room there shot up out of the earth a little forest of young ashes, which are now in a flourishing way, being about three or four foot high. There are above fifty of them just where the pipes lay, and none in any other part of the yard. There is no ash-tree there-

*Young trees
springing from
rotten wood.
By Mr. Geo.
Cramer to
Dr. Jurin.
n. 419. p. 282.
March, &c.
1730.*

about, nor perhaps within a great distance of the yard, which is in the town of Geneva.

An apple-tree bearing fruit without blossoming. By P. Dudley, Esq; n. 384. p. 199. Oct. &c. 1724.

Experiments on the motion of the sap in trees and plants. By Mr. Tho. Fairchild, n. 384. p. 127. July, &c. 1724.

VII. AN apple-tree here bears yearly a considerable quantity of fruit, yet never had a blossom; as I am assured, not only by the owner and many of the neighbours who have known it these forty years, but also by my own careful observation the three last seasons.

VIII. THE following experiments on the course of the sap are so useful, that I can thereby make barren trees fruitful, decaying trees healthful, and the system of gardening and planting more useful to the public.

I formerly shewed before the society the laureola grafted upon the mezereon, and the evergreen oak of Virginia upon the common English oak; both which hold their leaves all the winter and continue in good state and flourishing, though grafted on plants that drop their leaves in winter; which plainly proves that the juices rise upwards in winter in those plants that drop their leaves, otherwise the evergreens that are grafted on them would soon perish.

I believe by grafting the variety of foreign oaks on the English we might make the timber more firm and lasting than it is in its own nature when raised from foreign acorns: for as the crab-stock maketh the wood of the apple-tree more firm and lasting than that on the apple-stock, and peaches and almonds budded on plumbs are more lasting than those on peach-stocks; so by the contrary rule, all firm timber grafted on spongy stocks would be made worse than if it were on its own bottom. For example, if that which is called the English elm should be grafted on that which is called the Dutch, it would partake of abundance of the spongy juices of the stock and become unfit for the purposes it is now used for.

The first experiment I have now to offer is made on the N. England cedar, or rather juniper, grafted on the Virginia; and what is remarkable is, that the grafted branch is left several inches below the grafting, which part continues growing as well as that above the grafting.

The second is on the viburnum; its top is planted in the ground and become roots; and the roots are turned up and become branches. But whether the same vessels which fed the branches have changed their course, or whether the juices go up and down in the same vessels I shall leave to better judgments; but I find the plant in as good a state of growing as it was in its natural position.

The third experiment is made on a pear-tree, which I enarched upon two pear-stocks in March 172¹/₂, and it is now in a good flourishing state with a branch in blossom, and receiveth no nourishment but by the two enarched branches, the root being out of the ground; and though it was done above two years ago it is now shooting suckers out of the root, which proveth that the branches are as useful to support the roots as the roots the branches; and it is therefore no wonder that so many trees miscarry in planting, when there are no branches left on the head.

The

The fourth experiment is made on the cedar of Libanus grafted on the laryx; which last drops its leaves in the winter, yet maintains the cedar in as flourishing a condition as if it had been on a tree that held the leaves all the winter; and the part of the graft left below the grafting is in as good health as the part above it.

IX. 1. In Sept. 1729, I placed some bulbs of tulips and other flowers in water after such a manner as the figures represent; putting into each glass two grains of salt-petre. These glasses I kept in my study, sometimes on a shelf, at other times before the window. In a fortnight's time I began to find that they struck new roots; by the latter end of Nov. they put forth leaves, and in Jan. they all flowered as well as if they had been on a garden-bed; whereas in gardens we Swedes seldom see tulips before the latter end of May, and this year scarce so soon, the ground being now in April covered with ice and snow. Though this experiment seems calculated for nothing but delight, yet I think it furnishes some lights as to the rise of the sap in plants.

An experiment to make bulbous plants flower much sooner than they do in the ground. By Mr. Martin Triewald. n. 418. p. 79. Mar. & c. 1731 Fig. 67, 68.

IX. 2. THE glasses marked N° 1, were roots of a hyacinth commonly known by the name of pulchra. N° 2, were roots of the common oriental blue hyacinth. The flowers of these were not so large as they are commonly produced when planted in a bed of earth; but this was occasioned by the bulbs dividing into several off-sets, each of which are as so many different small roots sending forth stems and leaves. N° 3, was a bulb of a tulip, which though placed on the glass of water at the same time as the hyacinths, yet was not likely to flower in a month. N° 4, was a root of narcissus. This was also as backward as the tulip, though put upon the water at the same time with the hyacinths. These roots were placed upon the glasses the beginning of Nov. last; at which time I put them into a greenhouse, where the air was kept constantly in a temperate warmth. The glasses were filled with common Thames water, so near to the top that when the bulbs were placed upon the glasses it might be a quarter of an inch below the bottom of the bulbs. Into those glasses marked N° 5, I put a small quantity of common garden mould, to try whether that would forward their flowering or encrease their strength: but I found that all the roots which were placed on those glasses into which the earth was put, were at least a fortnight later than the others before their fibres were emitted, and their progress has been since much slower. I also observed that the water, in those glasses where the earth was put, did not waste above half so fast as it did in those glasses where there was none; which I conceive, might be occasioned by the terrestrial matter mixing with the water, and so rendering it thicker and less capable of being attracted by the plants, or evaporated by the heat. And from those glasses where the bulbs did not exactly cover their necks the water evaporated much faster than from those where the bulbs did entirely cover the tops of the glasses so as to leave no va-

Tried with success. By Mr. Phil. Miller. ibid. p. 81.

cuities round them. In about a month after the roots were put upon the glasses of water they began to put out their fibres into the water; but they did not begin to put forth their leaves 'till their fibres were extended all over the glasses, and were almost as full grown as at present. When their leaves began to appear the buds of the hyacinth-flowers were soon visible, and in about three weeks time were fully blown. The tulips and narcissus's being much backwarder than the hyacinths (as they always are when planted in a garden) these should always be placed upon the glasses of water six weeks or two months earlier in the season than the hyacinths, when they are designed to flower at the same time; and the præcoces (or early blowing) tulips should always be chosen for this purpose.

By this method a person who has not a garden may have some of these flowers growing in his chambers, where if they are not kept too close from the air or in a place too warm, they will flower almost as well as in a bed of earth, provided the roots are good and are every year renewed; especially the tulips, because the old bulbs being always exhausted in nourishing the leaves and flowers, a new one is annually produced by the side of the flower-stem. The hyacinths I have observed to flower two years successively upon glasses of water; but their flowers were very weak the second year; so that it is much the better way to have fresh roots every year.

*A method of
raising hard
shelled exotic
seeds. By the
same, to Dr.
Douglas.
n. 403. p. 485.
July, &c.
1728.*

X. IN 1724 I had a parcel of fresh coco-nuts given me which were brought over from Barbados: part of these nuts I divested of their outer coat or husk, and the other part I left intire as I received them. Both these parcels I planted in large pots filled with good fresh earth, and plunged the pots into a hot-bed made with tanners-bark; giving them gentle and frequent waterings as the earth in the pots seemed to require; but had not one out of the whole number that made any attempt to shoot, as I could perceive; and upon taking them out of the pots I found they were rotten. About four months after I received another fresh parcel of coco-nuts from Barbados, which I treated in another manner: from part of these I cut off the outer coat or husk, and the other part I left entire as before: but supposing it was owing to my planting the other parcel in pots that they did not succeed, I made a fresh hot-bed (with horse-dung) and covered it over with fresh earth about 18 inches thick, in which I planted the nuts: observing, as before, to supply it with convenient moisture, as also to keep the hot-bed in an equal temper of heat (which I was guided to do by a thermometer graduated for the use of hot-beds); but with all my care I had no better success than before; not one of the nuts making any essay towards shooting. The year following I had another parcel of coco-nuts given me, which, considering my former ill success, I planted in a different manner. Having a hot-bed, which had been lately made with tanners-bark, and which

was

was filled with pots of exotic plants, I removed two of the largest pots which were placed in the middle of the bed, and opening the tanners-bark under the place where the two pots stood I placed the two coco-nuts therein, laying them side-ways to prevent the moisture (which might descend from the pots) from entering the hole at the base of the fruit, and thereby rotting the seminal plant upon its first germinating. I then covered the nuts over with the bark two or three inches thick, and placed the two pots over them in their former station. In this place I let the nuts remain for six weeks; when removing the two pots and uncovering the nuts, I found them both shot from the hole in the base of the fruit, an inch in length; and from the other end of the fruit were several fibres emitted two or three inches in length. Finding them in such forwardness I took them out of the bark and planted them in large pots filled with good fresh earth, plunging the pots down to their rims in the tanners-bark, and covering the surface of the earth in the pots half an inch thick with the same: soon after which the young shoots were above two inches long and continued to thrive very well. I have communicated this method since to some of my acquaintance who have tried it with the same success; and if the nuts are fresh scarce any of them miscarry. This led me to try if the same method would succeed as well with other hard-shell'd exotic seeds, which I could not, by any method I had before tried, get to grow, as the bonduc or nickar-tree; the abrus or wild liquorice; the phaseolus Brasilianus frutescens lobis villosis pungentibus maximus Hermanni, or horse-eye bean, with several others; and I have found it both a sure and expeditious way to raise any sort of hard-shell'd fruits or seeds. For the heat and moisture (which are absolutely necessary to promote vegetation) they here enjoy in an equal and regular manner; the tanners-bark (if rightly managed) keeping to near an equality of heat for six months, and the water which descends from the pots when they are watered is by the bark detained from being too soon dissipated: which cannot be obtained in a common hot-bed, the earth in such being worked away by the water, and thereby leaving the seeds often destitute of moisture. Some of these seeds I have had shoot in a fortnight's time; which I am informed would not have so done in a month in their native soil and climate. I have also found this to be an excellent method to restore orange (or any other exotic) trees, which have suffered by a tedious passage in being too long out of the ground: insomuch that I recovered two orange-trees which had been ten months without either earth or water.

XI. THE Alpine plants become less and less, as the mountains upon which they grow rise higher. Whether this be owing to the sharpness and purity of the Alpine air, or the decreasing pressure of the atmosphere which is far less upon mountains than in valleys and low countries,

Of the smallness of the Alpine plants.
By Dr. J. G. Scheuchzer.
n. 406. p. 593.
Dec. 1728.

countries, or to a want of a sufficient quantity of subterraneous heat to push the nourishment into the roots and vessels of the plants, or rather to a joint concurrence of these and other causes, would require a more leisurely consideration. The thing itself is an indisputable matter of fact, and it extends also to trees and shrubs, which become smaller as they grow higher. Nay, what is still more remarkable, no trees will grow beyond a certain height; which is the reason why the tops of mountains appear so bare and naked if viewed at a distance, though a curious traveller shall not fail meeting upon their rich pastures with an agreeable variety of beautiful plants. The height where trees cease to grow hath been found, by barometrical observations, nearly the same in diverse parts of Swisserland. However, the smallness of the Alpine plants is abundantly compensated by their great virtues, which are, as it were, purposely contracted into a narrow compass.

*Observations
on plants and
the power of
vegetation in
N. England.
By P. Dudley
Esq; n. 385.
p. 194. Oct.
&c. 1724.*

XII. ALL the English plants that have been brought over hither suit mighty well with our soil and grow here to great perfection; that the curious may better make a comparison I shall single out a few particulars of my own observation.

Fruit-trees.] Our people, of late years, have run so much upon orchards that in a village near Boston, consisting of about forty families, they made near three thousand barrels of cyder. This was in 1721. And in another town of two hundred families, in the same year, I am credibly informed, they made near ten thousand barrels. Some of our apple-trees will make six, some have made seven barrels of cyder, but this is not common; and the apples will yield from seven, to nine bushels for a barrel of cyder. A good apple-tree with us will measure from six to ten foot in girt. A Kentish pippin at three foot from the ground, seven foot in girt; a golden russetin six foot round. The largest apple-tree that I could find was ten foot and six inches round, but this was no graft. Our apples are, without doubt, as good as those of England, and much fairer to look to, and so are the pears; but we have not got of all the sorts.

I have seen a fine pearmain a foot from the ground measure ten foot four inches round. This tree in one year has bore thirty eight bushels (by measure) of as fine pearmain as ever I saw in England. An orange pear-tree grows the largest and yields the fairest fruit. I know one of them near forty foot high, that measures six foot and six inches in girt a yard from the ground, and has bore thirty bushels at a time; and this year I measured an orange pear that grew in my own orchard eleven inches round the bulge. I have a warden pear-tree that measures five foot six inches round. One of my neighbours has a bergamot pear-tree, that was brought from England in a box about the year 1643, that now measures six foot about, and has bore twenty two bushels of fine pears in one year. About twenty years since the

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owner took a cyon and grafted it upon a common hedge pear, but the fruit does not prove altogether so good, and the rind or skin is thicker than that of the original.

Our peach-trees are large and fruitful, and bear commonly in three years from the stone. I have one in my garden of twelve years growth, that measures two foot and an inch in girt a yard from the ground, which two years ago bore me near a bushel of fine peaches. Our peaches do rather excel those of England, and then we have not the trouble or expence of walls for them; for our peach-trees are all standards, and I have had, in my own garden, seven or eight hundred fine peaches of the rare-ripes growing at a time on one tree.

Our common cherries are not so good as the Kentish cherries of England, and we have no dukes, or heart-cherries, unless in two or three gardens.

Forest-trees.] Some years since I measured a *platanus occidentalis*, or button wood tree (as they are called here) of nine yards in girt, and it held its bigness a great way up. This tree when it was cut down, I am informed, made twenty two cord of wood. A gentleman tells me that in the forest he met with a streight ash, which grew like a pillar of a great height, free from limbs, and measured fourteen foot eight inches round near a yard from the ground; and the other day I met with a *sassafras* tree that measured five foot three inches in girt. I meddle not here with our noble pines and cedars, because I design to treat of them among the evergreens of this country. Among our trees of quick and easy growth, the button-wood before mentioned, and the locust-tree, are the most remarkable: as to the latter, by the description Mr. Moore while here gave me of the manna-tree, our locust-tree may be called the American manna. I have known a seed of it blown off from the tree into my garden, that took root of itself, and in less than two years was got above six foot high, and as big about as a common walking cane. The *platanus* I have frequently propagated, by cutting off sticks of five or six foot long and setting them a foot deep into the ground in the spring of the year, when the season is wet; they thrive best in a moist soil.

An onion set out for seed will rise to four foot nine inches in height. A parsnip will reach to eight foot, red orrice will mount to nine foot, white orrice eight. In the pastures I measured feed mullen nine foot two inches in height, and one of the common thistles about eight foot.

The following account I have well attested from a worthy divine, viz. that in 1699 a single pumpkin seed was accidentally dropped in a small pasture where cattle had been foddered for some time and took root of itself without any manner of care; the vine run along over several fences, and overspread a large piece of ground, continuing its progress 'till the frost came and killed it. This seed had no more than one stalk, but a very large one; for it measured eight inches round;

round; from this single vine they gathered two hundred and sixty pumpkins, each, one with another, as big as a half peck; besides a considerable number of small and unripe ones that they made no account of. The Phil. Trans. give an account of a single plant of barley, that by steeping and watering with salt-petre dissolved in water produced two hundred and forty nine stalks, and eighteen thousand grains; but then there was art, and even force in that case; whereas in ours, there was nothing but pure nature.

Our Indian corn is the most prolific grain that we have, and commonly produces twelve hundred, and often two thousand grains from one; but the fairest computation is thus; six quarts of this grain will plant an acre of ground, and it is not unusual for an acre of good ground to produce fifty bushels of corn. It is remarkable that this Indian corn has always an equal number of rows of grain on the ear, as eight, twelve, &c.

I shall but just mention what is frequently observed in our gardens, with regard to the winding or running vines, more especially the hop and the French or kidney bean; how contrary they are to one another in their climbing, and yet how steadily they observe their own laws; the hop-vine winding about the pole with the sun, and the bean against the sun, and this course they keep with such obstinacy, that though an attempt has been made over night to force them to change it, yet by morning they have got back again to their natural turn.

*An account of
the Poison-
tree in N.
England. By
P. Dudley,
Esq. n. 367.
p. 143. Jan.
&c. 1721.*

XIII. I. THE Poison-tree grows only in swamps, or low wet grounds, and is something like a small ash, but much more like a sumach, and therefore is by some called the swamp sumach, for the twigs, leaves and shape are exactly like the sumach, and it likewise bears a dry berry. It never grows bigger than a man's leg nor taller than alder, but spreads much, and several together, especially about the stump or roots of one that is cut down; as it is of quick growth so it does not last long; the inside of the wood is yellow and very full of juice as glutinous as honey or turpentine; the wood itself has a very strong unsavory smell, but the juice stinks as bad as carrion. It poisons two ways, either by touching or handling it, or by the smell; for the scent of it when cut down in the woods, or put on the fire, has poisoned persons to a very great degree. One of my neighbours was blind for above a week together with only handling it. And a gentleman in the country, sitting by his fire-side in the winter, was swelled for several days with the smoak or flame of this wood. It has this effect only on some particular persons and constitutions; for I have seen my own brother not only handle, but chew it without any harm at all. And by the same fire one is poisoned while another is not at all affected. However, this poison is never mortal, but goes off in a few days of itself; yet generally we apply plantain water, or sallet-oil and cream. As to its operation, within a few hours after the person is poisoned

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he feels an itching pain that provokes scratching, which is followed by an inflammation and swelling; sometimes a man's legs only have been poisoned and have run with water. My neighbour that was so sadly poisoned with handling it told me one thing very remarkable, and that is, that when he touched it he plainly perceived it to differ from the other wood that he was throwing into his cart, by its being as cold as a piece of ice; and withal assured me that he could distinguish it blindfold from any other wood in the world by its coldness; but the poor man is as much afraid of it when he goes into the woods as of a rattle-snake. He further tells me that he felt an itching in a few hours after he had handled the wood, but the swelling did not come on 'till about three days after.

XIII. 2. THE following account of the Poison-tree I had from Mr. Moore, who probably had it from Mr. Dudley.

A farther account of the same tree. By Dr. W. Sheppard, ibid. p. 147.

"It grows to the bigness of elder; I never saw the leaf; the wood is as cold as ice; when laid on the fire, of five or six persons sitting by it some will fall a swooning, fainting, or yawning, and continue so for several days, some but a few hours, and others of the company are not at all affected. I and many others handle, cut and burn it with impunity. It was never known to kill any body; I have sent you all the seeds of it I can get."

The seeds he sent were but few, but I had a good quantity from Mr. Catesby in Carolina, who calls it a water-shrub of which he never saw leaf or flower. 'Tis a species of *toxicodendron*, though not named by Tournefort in his Institutions, p. 610, but I believe it to be *arbor Americana alatis foliis, succo lacteo, venenata*. Pluknet. Almag. 45, tab. 145, fig. 1, which is a species of *toxicodendron* that grew formerly at Chelsea garden. What makes me think so is Mr. Dudley's writing that 'tis like a sumach, and that it is by some called the swamp-sumach; this in its manner of growing and alated leaves very much resembles the sumach or *rhys*; the fruit is a white roundish dry berry, growing in clusters, so like that of *toxicodendron triphyllum folio sinuato, pubescente*, Inst. R. Herb. 611, *hederæ trifoliæ Canadensis affinis planta: arbor venenata quorundam H. R.* Paris. as scarce to be distinguished from it.

XIV. CONTRAYERVA is a Spanish word, signifying as much as *herba contra [venena]* or an herb against poisons. And as there are in all countries different plants to which that virtue is ascribed, the name of *contrayerva* seems to have been given by the Spaniards to as many of them as have come under their knowledge; for Hernandez has described a species of *granadilla* by that name, and there are several other roots that are commonly known by it: but here I offer only a short account of that plant whose root is called *contrayerva* in England. This root being so commonly known that it would

An account of the Contrayerva. By Mr. W. Houstoun. n 421. p. 194. Off. &c. 1731.

be superfluous to describe it, I shall confine myself to the description of the plant that produces it, which I have not hitherto met with to my satisfaction in any author. F. Plumier, in his book entitled *Nova plantarum Americanarum genera*, describes a genus which he calls *Dorstenia*, whereof I have found two species in the W. Indies, the roots of which are gathered and exported indifferently, as being very much alike both in appearance and virtues. One of these I think may be called, *Dorstenia dentariæ radice, sphondylii folio, placenta ovali*, fig. 69. and the other, *Dorstenia dentariæ radice, folio minus laciniato, placenta quadrangulâ & undulatâ*, fig. 70.

Fig. 69.

Fig. 70.

The first kind seems to be the *tuzpatli* of Hernandez, p. 147. Its roots, which are perennial, put forth in the month of May (or as soon as it happens to rain) each six or eight leaves four or five inches long and as many broad, cut into several segments almost as deep as the middle rib, somewhat after the manner of the *sphondylium*: they stand upon footstalks five or six inches long; and from the middle of them come forth other footstalks somewhat longer, sustaining each a strange sort of body, flat and situated vertically, or with one edge uppermost, which I have called *placenta*. In this species it is of an oval figure, with its longer axis parallel to the footstalk. One side of it is smooth and green like the outside of the calix in other plants; but from the other arise a great many small yellow apices; and after they are gone many small roundish seeds begin to appear, which when ripe are somewhat like those of *gromwell* or *lithospermum*. It grows in the kingdom of N. Spain, near old Vera Cruz, on the high ground, by the side of the river.

The second kind has much the same number of leaves growing from each root as the former; but of a different figure, for some of them are entire and shaped like those of a violet, others angular like leaves of ivy, and some almost as much divided as the leaves of the common maple. They are thin, of a dark green colour and smooth, having only a few scarce perceptible hairs on the back. The pedicles that sustain the flowers arise immediately from the root as in the other species, and attain to the same height of six or eight inches. But the *placenta* which sustains the flowers is in this kind quadrangular, waved about the edges, and broader transversely than vertically. Yet the flowers and seeds themselves are perfectly the same as in the other. This second kind grows plentifully on the high rocky grounds about Campechy, where I gathered it in perfection in the beginning of Nov. 1730. I cannot guess why F. Plumier has called this a monopetalous plant; for that which he calls the *petalum* and I the *placenta* is of a green colour, and (which is of more consequence) sustains the seeds when ripe, and never envelops the organs of generation when young; so that I think it can by no means be called a *petalum*, nor even properly a *calix*, and therefore I have given it the name of *placenta* whose office it certainly performs. I

I have not been able to observe exactly the structure of the organs of generation because of their excessive smallness; but they appear to the naked eye as they are represented in the figures I have given of them, and in Plum. N. G. tab. 8. The *Dorstenia sphondylii folio dentariæ radice* of Plumier differs from both of mine; for in his drawings done by order of the late king of France, whereof I have seen a copy in the collection of the late Dr. Sherard, the leaves are represented serrated, the placenta quadrangular, and the roots consisting of several knobs tied together lengthways. From which last particular I am persuaded that the root of that species is the *Drakena radix* mentioned by Clusius in his *Exotics*, p. 83.

XV. THE root called *Ipecacuanha* is either true or false. Of the true I have four kinds, black, brown, grey, and white; but I cannot pretend to determine whether they belong to different plants, or are only varieties of the same plant owing to the soil in which they grow, as is affirmed by Sir Hans Sloane. And as they are never imported entire it is impossible to give any certain description of them in that state. However, by comparing the several dried pieces we may very probably conjecture that a short radical trunk descends from a caulis, and is afterwards divided into several large branches, and these again into smaller ones, with minute filaments or fibrillæ going out from them. Each piece is made up of an outer or cortical and an inner or fibrous part; the latter like a white nerve or smooth compact fasciculus of woody filaments run through the axis of the root, and perhaps encloses within it a small pith hardly discernable by the naked eye. The cortical part is corrugated by superficial circular rings or little knots which do not go quite round, and has deep fissures reaching all the way to the nerve. How long the entire roots are is uncertain: I have met with some pieces above nine inches, and many above six; they are generally bent and wreathed into several figures; few being quite streight.

Of the different kinds of Ipecacuanha. By Dr. Douglas. n. 410. p. 152. July, &c. 1729.

In these things all the true *Ipecacuanha*-roots agree; but there are several other particulars in which they differ. The black sort is the smallest, very hard, with wide and numerous fissures. The outward colour of the cortex is not equally black in all, and its inner substance as well as the nerve is mostly white. The brown is larger than the black, the fissures at larger distances, the inner substance of the cortex darker, and its external colour more or less red. The grey is sometimes of a darker, sometimes of a lighter colour, and the inner substance of the cortex is brown streaked with white. It is much larger than the black, many pieces being above a quarter of an inch in diameter, but the nerve is smaller in proportion to the cortical part. I have met with few pieces of it above five inches long. Its fissures are still fewer than in the brown, and in some pieces there are scarce any. The superficial corrugations are various, some roots being almost smooth, and in others the wrinkles are rather longi-

tudinal than circular. The white is of very different sizes ; some pieces being larger than any of the grey sort, and others much less. The whitish colour of the cortex has a yellowish cast, and the nervous part is very large in proportion to the rest. It has very few fissures, and hardly any reach so deep as the nerve. The other corrugations are likewise very shallow, and most of them longitudinal; but it is more knotty than the other kinds, which seems owing chiefly to the fibrillæ that go out from the larger branches of the roots.

Where these species of *Ipecacuanha* grow has not as yet been fully settled. The black sort is hitherto known to come only from Brasil by the way of Lisbon, and some of our druggists for that reason distinguish it by the name of the Brasil root. The brown sort, as I am informed by Dr. J. Houston who resided for several years in N. Spain, grows plentifully about Carthagená in N. Granada ; from whence it is frequently sent to Jamaica and so to England, where we have had it of late in great abundance. The grey we prefer to all the rest. It is said to grow in Peru, from whence it is brought to Porto-Bello, and so into Europe by the Spanish galleons. Some parcels thereof are likewise probably sent from Porto-Bello to Jamaica ; for it has sometimes been imported hither from thence. By specimens of it brought me from St. Thomé, a Portuguese island under the equinoctial, whither they were sent directly from Brasil, it is evident that this species is likewise a native of that country, and therefore must either have been included by Piso under one of the two species mentioned by him, or else discovered since his time. According to F. Labat, in his late voyage to the islands of America, this species grows plentifully in Martinico, as well as the white sort which is also said by Piso to grow in Brasil.

These are the four kinds of true *Ipecacuanha* which have hitherto come to my knowledge ; but I have met with two other roots falsely so called, which from their outward colour I shall call white and brown. The white sort agrees pretty much in appearance with the true white, but is not near so knotty. It is likewise considerably larger, straighter and softer to the touch. The brown is of a deeper colour than the true brown, and many pieces thereof have a mixture of red (from whence it has been sometimes called red *Ipecacuanha*) and the inner substance of the cortex inclines to a reddish yellow. The pieces thereof are much longer than any of the former sorts, some of them measuring sixteen inches, and they are of a size between the black and the grey. The fissures are at greater distances from one another than in the true brown, and the spaces between them much smoother ; yet it is not easy to distinguish them unless they be attentively compared. Both these false kinds were brought me from Maryland in 1725 by a surgeon, who informed me that they grow there in great plenty, being called *Ipecacuanha* by the inhabitants and used as such by the meaner sort. I have since received a sample of the brown sort, taken from a parcel

cel which lay in the custom-house above twelve years ago under the name of wild Ipecacuanha. Sir Hans Sloane informed me that this false brown kind was formerly sent to him from Virginia for the true Ipecacuanha, and that he afterwards discovered it to be the root of a poisonous apocynum described in his Nat. Hist. of Jamaica; in which island it is very common, and likewise in N. Spain, as appeared from the specimens sent him by his correspondent Dr. Burnet. In his introduction to Vol. II. of that excellent history, he has obliged us with a very full and distinct account of what he had learned from his friends abroad concerning the pernicious effects of the several parts of this plant, and of the great pains he was at to prevent its being brought into use in this country, which was then very much to be apprehended. Helvetius's name will always be mentioned with honour for the great share he had in bringing the true Ipecacuanha into credit in Europe; and I cannot think Sir H. Sloane deserves much less praise for having detected this false kind which was insensibly creeping into its place, and might otherwise have proved as fatal as the other is beneficial. This poisonous plant is now cultivated by several curious persons about London.

XVI. 1. THE best sort of cinnamon, which grows in great plenty in Ceylon and is peculiar to that island, is called by the natives Rasse Coronde, i. e. sharp, sweet cinnamon: it is exported yearly by the Dutch E. I. Company, who have ordered under several penalties that no other sort be mixed with it.

The second sort is called Canatte Coronde, that is, bitter and astringent cinnamon. The bark of this tree comes off easily, and smells very agreeably when fresh, but hath a bitter taste. It is an advantage to us that it is not very plenty, because one might easily mistake it for the best; as indeed it requires a good deal of skill and attention to distinguish the cinnamon trees from each other. The root yields very good camphire.

The third sort is called Capperoe Coronde, i. e. camphorated cinnamon, because it smells and tastes very strong of camphire. It grows plentifully enough in the island, but not in the eastern parts of it: however they find means now and then to send it over privately and sell it to the Danes and English, who come to trade upon the coasts of Cormandel. Besides there is a sort of canella on the continent of India about Goa which is very like this sort of cinnamon-tree, though it hath nothing of the true cinnamon. The same sort of canella agrees in many things with the canella Malabarica sylvestris, a wild cinnamon-tree growing on the coasts of Malabar. And though with regard to the shape of the tree, and the outward appearance of the bark and leaves, there is very little difference to be observed between these two sorts of canella and the best sort of cinnamon, yet the latter is vastly superior in richness, virtue and sweetness.

An account of the cinnamon-tree. By the chief inspector of the cinnamon trade in Ceylon. n. 409. p. 97. May, &c. 1729.

The fourth sort is called Welle Coronde, that is, the sandy cinnamon, because in chewing it feels gritty, though in fact there is nothing sandy in it. The bark of this tree comes off easily enough, but it is not so easily rolled up as the other sorts, being apt to burst open and unfold itself. It is of a sharp and bitterish taste, and the root yields but little camphire.

The fifth sort is called Sewel Coronde, that is, mucilaginous or glutinous cinnamon. This sort acquires in drying a very considerable degree of hardness. It hath but little taste and an ungrateful smell; yet its colour is very fine, and it is not many years since I first took notice that the natives mix a good deal of this with the best sort, the colour of both being very much alike, excepting only that in the good sort there are a few yellowish spots towards the extremities.

The sixth sort is called Nieke Coronde, the tree having a good deal of resemblance to another called Nieke Gas, and its fruit Nieke. The bark of this sort hath no taste or smell when taken off, and is used by the natives only as physic. For by roasting it they obtain a water and oil with which they anoint themselves, thinking thereby to keep off all sorts of noxious fumes and infections in the air. They likewise express a juice out of the leaves of it, which they say cools and strengthens the brain if the head be rubbed with it.

The seventh sort is called Dawel Coronde, that is, drum cinnamon. The reason of this appellation is because the wood of this tree is light and tough, so that the natives make some of their vessels and drums of it, which they call Dawel. The bark is taken off while the tree is growing, and is of a pale colour: the natives use it in the same manner as the sixth sort.

The eighth sort is called Catte Coronde, that is, the thorny or prickly cinnamon, because this tree is very prickly. The bark is in some measure like cinnamon, but the leaves differ very much, and the bark itself hath nothing either of the taste or smell of cinnamon. The natives use the root, bark and leaves of it in physic, applying them in form of cataplasms to tumours and swellings from a thick corrupt blood, which they say it cures in a short time.

The ninth sort is called Mael Coronde, or the flowering cinnamon, because this tree is always in blossom. The flowers come nearest those of the best sort, but they bear no fruit as the other doth. The substance of the wood never becomes so solid and weighty in this as in the other cinnamon-trees above-mentioned, which have sometimes eight, nine, or ten foot in circumference. If this everflowering cinnamon tree be cut or bored a limpid water will issue out of the wound, but it is of no use any more than the leaves and bark.

The Ceylonefe say there is still another sort of cinnamon, which they call Toupat Coronde, or the three-leaved cinnamon. It doth not grow in that part of the country which the Dutch E. I. Company

is possessed of, but higher up towards Candia. Having never seen it myself I will say nothing farther of it.

All the several sorts of cinnamon-trees, the best as well as the rest, must grow a certain number of years before the bark is fit to be taken off. Those which grow in vallies where the soil is a fine whitish sand will be ripe in five years: others which stand in a wet slimy soil must grow seven or eight years: those are later which grow in the shade of other larger trees; and their bark hath not that sweetness and agreeable taste observable in the bark of those which grow in a white sandy ground, where with little wet they stand fully exposed to the sun; but it is rather of a bitterish taste, something astringent, and smells like camphire. For by the heat of the sun the camphire is made so volatile that it rises up and mixes with the juices of the tree, where it undergoes a small fermentation, and then rising still higher between the substance of the wood and the thin inner membrane of the bark, it is at last so diffused through the branches and leaves that there is not the least sign of it to be perceived any where. Mean while that thin and glutinous membrane, which lines the bark on the inside between it and the substance of the wood, attracts and sucks in all the purest, sweetest, and most agreeable particles of the juice, the thick and gross ones being pushed forward to nourish the branches, leaves, and fruit.

I have often had occasion to prove this to curious persons. If the bark be fresh taken off that juice which remains in the tree hath a bitterish taste, not unlike that of cloves. On the contrary, if you taste the inner membrane of the bark when fresh taken off, you'll find it most exquisitely sweet and extremely agreeable to the taste, whereas the outward part of the bark differs but very little in taste from that of the common trees; which shews plainly that all the sweetness of it is owing only to the inner membrane. But when the bark is laid in the sun in order to its being dried and wound up, this oily and agreeable sweetness of the inner membrane diffuses itself throughout the whole outward part of it (which however hath been first stripped while yet upon the tree, of its outermost greenish coat) and imbues it so strongly that for the fragrancy of its smell and the sweetness of its taste it is coveted all over the world.

The bark may remain upon some trees, without losing its sweetness and virtue, fourteen, fifteen, or sixteen years, according to the quality of the soil they stand in; but after that time it loses by degrees its agreeable sweetness, and tastes stronger of camphire: besides, it is then grown so thick, that if it be laid in the sun it will no longer shrink and wind itself up, but remain flat.

In order to account for the vast quantity of cinnamon that has been and is still yearly exported from Ceylon, several authors have affirmed that when the bark hath been stripped off the cinnamon-trees it grows
again

again in four or five years, and becomes fit to be stripped a second time. But this is utterly false; for though the trees, after the bark hath been once taken off, are cut down to the very ground, yet the root quickly pushes forth new shoots, which grow up and ripen in five, six, seven or eight years, some sooner, some later, and then yield their bark. Thus far the old roots are instrumental to the growth and plenty of cinnamon-trees, but their fruit likewise contributes very much towards the same end: and it is particularly owing to a certain kind of wild doves, which from their eating the fruit of this tree they call cinnamon-eaters, that they grow so plentifully in this island; for the doves, when they fetch food for their young ones, disperse vast quantities of the fruit all over the fields, which occasions the rise of many thousand young trees.

The oil drawn from cinnamon by fire is reckoned one of the strongest cordial medicines: the camphire which comes out of the root is likewise of great use in several distempers, as are also the oil of camphire, a very costly thing, the leaves of the tree and the oil distilled out of them; and lastly, the fruits with their oil. In short, there is no part of the cinnamon-tree, but what is of some singular use in physic. I purposely avoid speaking of the large gains the company makes by the yearly export of this precious commodity.

*Additions to
the foregoing
account. By
Albert. Seba.
ibid. p. 106.*

XVI. 2. HAVING some years ago bought out of the E. I. Company's warehouses at Amsterdam a considerable quantity of cinnamon leaves, or folia malabathri, packed up in several large chests, I happened to find in one of them the fruit of the cinnamon, and also the flowers as big as the Italian bean-flowers and of a blue colour.

In 1722 and 1723, I bought of the same company the oil which is expressed out of the fruit of the cinnamon-tree, as also that which is boiled out of them, which is of a very good consistence and white, and is by the E. I. Company called cinnamon wax, because the king of Candia causes candles to be made out of it, which for their agreeable scent are burnt only by himself and at his court. However he permits his subjects to express the juice out of another fruit not unlike that of the cinnamon-tree; but this juice being only a thin fat substance, like oil of olives, they cannot burn it but in lamps. The Indians use this cinnamon wax also in physic, and give it inwardly in luxations, fractures, falls, contusions and bruises, that in case any inward part be touched or bruised, it may by its balsamic virtue heal them. They give it also in bloody fluxes to one dram or a dram and half. Outwardly applied it makes the skin more beautiful, smoother and softer than any one known sort of pomade.

The leaves of the cinnamon-tree yield also an oil, which is of a bitterish taste, resembling oil of cloves mixed with a little good oil of cinnamon. It is called oleum malabathri, or oil of cinnamon leaves. It is an aromatic, and is reckoned an excellent remedy in headaches, pains of the stomach, and other distempers.

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The oil of the root of the cinnamon-tree is, properly speaking, an oil of camphire, whereof the roots afford a good quantity. About two years ago I bought a bottle of it of our E. I. Company; there were several together in a box, upon which was written in low Dutch, "These oils were sent as a present out of Candia", which shews that they are genuine, without any adulteration; accordingly they are much esteemed. If this oil be distilled in glass vessels, there comes over along with it that sort of camphire which the Indians call camphire Baros, or camphire of Borneo, which shoots in thin transparent chrystals, forming a beautiful variety of trees on the recipient, not unlike those which in very frosty weather are to be seen upon windows. This sort of camphire is of very great efficacy in physick, and is gathered and kept for the king of Candia's own use, who esteems it an excellent cordial medicine. But not only the camphire Baros, but also the oil of camphire, which is drawn out of the roots of the cinnamon-tree, is a very great cordial, if taken inwardly: it strengthens the stomach, expels wind, and hath been found of great use in arthritic and gouty disorders: it is also a diuretic. The dose is ten or twelve drops upon a bit of sugar, or in a proper vehicle. Outwardly it is applied in all arthritic pains from cold and obstructions, being rubbed on the affected part with a warm hand, and presently lessens the pain, and by degrees takes it off. About six and thirty years ago while I served in the shop of Mr. Dumbstdorff at Amsterdam, that gentleman was so cruelly afflicted with arthritic pains that he could have no rest night nor day; and though he called in the assistance of several noted physicians and tried abundance of medicines, yet he could find no relief, 'till he was advised to get himself anointed with the oil of the root of the cinnamon-tree. I remember very well that I anointed him myself, rubbing the oil on all the affected parts with my hand warm'd by holding it to an oven, and this I did twice every day for an hour together. And though when this cure was first begun with him his hands and feet were by the convulsions and the violence of his pain so contracted that they were quite crooked and full of nodes, yet in a fortnight's time he grew so much better that he could sleep well at nights without pains or cramps. In about six weeks time he could walk about his room, whereas before he was not able to stir either hand or foot. This anointing was continued for about three months, when the patient not only recovered of that violent indisposition, but continued free from the gout ever after, and lived about fifteen years in a very good state of health. And not only this I can affirm to be true of my own certain knowledge, but also that since that time I have advised several people in his condition to do the same with as good success. Several physicians have written largely of the virtues of common camphire, but there are as yet many hidden qualities in this excellent medicine. Thus, for in-

stance, I can affirm that in all burnings by fire or otherwise, and the pains occasioned thereby, I have not yet met with any better and surer medicine than this, “ R. Spir. Lumbricor. terrestr. cum Spir. Vini rectificat. $\mathfrak{z}$ xij. Camphor. $\mathfrak{z}$ ij. M. No sooner is a bandage or compress dipped into this spirit applied to the affected part but it gives instant relief, and so effectually checks the inflammation that it creeps no farther. But the application of it must be continued 'till the pain is quite gone, and the ulcer, if there hath been any, is dried up. If the exulceration is got deeper, and the wound must be kept open, two ounces of camphire dissolved in oleo hyperici, mixed with a pound of the common unguentum cerussæ and applied according to art will quickly and effectually heal it, as I have often experienced.

*A description
of the flower
and seed-ves-
sel of the Saf-
fron-plant.*

By Dr. J.
Douglas.

n. 380. p. 441.
Nov. & c. 1723

Fig. 71.

XVII. 1. THE flower of this curious plant is of the lilly kind, monopetalous, infundibuliformis, without any calyx or perianthium, its long fistulous beginning being afterwards expanded into six oblong segments. A. A. fig. 71.

It consists of the following parts, viz. the petalum, stamina, apices, ovarium, and stylus with its capillamenta tubiformia.

The petalum is distinguished into a long, fistulous part, inclosed within the common and proper involucra of the plant, arising from the top of the ovarium or seed-vessels, and six segments, *a. a.* While this narrow, tubulous part runs between the leaves and the integuments that surround them it is white, but afterwards insensibly acquires a purple colour, which inclines to red a little before its division where it begins to grow more open. About one or two inches above the theca communis it divides into six oblong purple-coloured petala, *b. c.* three of which are larger than the rest, but in all other respects much alike, *c. c. c.* The length of the largest is from $1\frac{1}{4}$ to 2 inches; the breadth seldom above $\frac{1}{2}$ inch: the shorter leaves are from 1 to $1\frac{1}{4}$ inch in length, their breadth a little less in proportion. The inside of each is of a violet purple-colour, veined with a few small lines of a deeper dye running length-ways, intermixed with white, or the whole is beautifully chequered with blue and white. The outside is of a whiter blue with several whitish risings or ridges, and just at the bottom of the leaf it is of a deeper blue; the three small leaves, *b. b. b.* are much of the same colour, only the purple seems to be something deeper. The number of the petala is generally six; yet some flowers have seven or eight; but then they are not so large.

In every flower there are three stamina, or chives, properly so called, arising from the inner surface of the tubular part of the flower just before its division into the petala, where they make for some space an apparent ridge, and then they stand upright, opposite to the three large leaves; they are of a whitish colour, inclining to a light purple, and but little above $\frac{1}{4}$ of an inch in length. In those places that have seven or more petala, the number of the stamina is likewise increased to five, or more.

Each

Each of these stamina has its proper apex, *e. e. e.* which is a longish substance standing upright opposite to the larger flower-leaves, yellow, forked, not unlike the tongue of a small bird at the lower end; here likewise it is broadest, but as it ascends it becomes narrower, and its upper extremity is turned a little to one side: it seldom exceeds $\frac{1}{2}$ inch in length. It appears as if it were double, with a longitudinal furrow in the middle, in which hollow the stamen seems to be faintly continued for some space. When the plant is fully grown they are all loaded with the farina foecundans.

The ovarium, *f. f.* called likewise the vasculum seminale, and pistillum by some, arises from the top of the pedunculus, *g.* and is about $\frac{1}{4}$ of an inch long or a little more, of a deep whitish colour, three cornered, and divided into three loculamenta or capsulae, wherein the seeds (which however seldom come to perfection with us) are formed, growing bigger and bigger after the flower falls off; nay, even in this blooming state, if you cut this vessel across the middle you may perceive the whitish rudiments of the seeds.

From the upper part of the ovarium arises the stylus, *b.* which is a long slender tube enclosed within the fistular portion of the flower, being there of a whitish colour, but changing into a yellow before its division. This stylet ordinarily splits into three parts, just opposite to the top of the stamina where the apices take their rise, *i. i. i.* and thus far it stands upright in the middle of the stamina; for the sake of which only this plant is cultivated.

I call these parts of the stylus, from their figure and shape, capillamenta tubiformia, or appendices styli salpingooides, as they very exactly represent a trumpet and are not unlike the fallopian tube in women, being narrow at their origin and growing gradually larger towards their other extremity; which is open and expanded, and jagged or fringed at the edge, *k. k. k.* It may also be very fitly named *crocus officinarum*, because that is the only part that is used in the shops. They are yellow just at their beginning, continued from the upper part of the stylus, but afterwards of a deep red, only their jagged extremities are tipped with a white inclining to yellow. These tubae or capillamenta are from 1 to 1 $\frac{1}{2}$ inch in length. The stylus while undivided is strong enough to support itself, being enclosed within the tubular part of the flower; but the capillamenta being very weak and slender at their beginning hang down between the petals.

Fig. 71 represents a root of the saffron-plant that has two stalks enclosed in one common vagina, the whole flower with the stamina and apices in one, and the stylus only in the other; with the leaves, pedunculi, and ovarium in both.

- | | |
|---|---|
| <i>A. A.</i> The flower expanded into six beautiful segments. | <i>f. f.</i> The vasculum seminale. |
| <i>a. a.</i> The fistulous part of the flower. | <i>g. g.</i> The pedunculi. |
| <i>b. c.</i> The six petala. | <i>b. b.</i> The stylus. |
| <i>c. c. c.</i> The three larger petala. | <i>i. i. i.</i> The 3 capillamenta tubiform. |
| <i>b. b. b.</i> The three smaller ones. | <i>k. k. k.</i> The jagged extremity of the capillamenta. |
| <i>d. d.</i> The three stamina or chives. | <i>B. B.</i> The root. |
| <i>e. e. e.</i> The three apices. | <i>C. C.</i> The grassy leaves. |

Of the culture of Saffron in England. By the same. n. 405. p. 566. Nov. 1728.

XVII. 2. SAFFRON has been longest and most cultivated in a circle of about ten miles diameter between Saffron-Walden and Cambridge, and therefore the inhabitants of that place may be supposed best acquainted with the management of it. From them the following observations were collected by my order in the years 1723, 4, 5, and 8.

This country is open and level: and here, as in most other places, they crop two years, and let the land lie fallow the third. Saffron is always planted upon fallow ground, and that which has born barley the year before is preferred. The saffron-grounds are seldom above three acres, or less than one, and in choosing them the principal thing they have regard to is, that they be well exposed, the soil not poor nor stiff clay, but a temperate dry mold, such as commonly lies upon chalk, and is of a hazel colour; though if every thing else answers the colour of the mold is pretty much neglected. About Lady-day or the beginning of April the ground is carefully ploughed, and the furrows drawn much closer together and deeper, if the soil will allow it, than is done for any kind of corn. About five weeks after, they lay between 20 and 30 loads of dung upon each acre, and having spread it with great care plough it in as before: the shortest rotten dung is the best. About midsummer they plough a third time, and between every pole in breadth they leave a wide furrow, which serves both for a boundary to the several parcels and to throw the weeds into at the proper season. The fences consist of hurdles to keep out cattle of all sorts, but especially hares, which would otherwise feed on the saffron-leaves during the winter. The hottest summers are the best, and if therewith there be gentle showers from time to time, they hardly miss of a plentiful rich crop, unless extreme cold, snow, or rain of the foregoing winter have prejudiced the heads.

The time of planting is commonly in the month of July, a little sooner or later, according as the weather answers. The method is this. One man with a narrow spade called a spit-shovel raises between three and four inches of earth, and throws it before him about six or more inches; two persons following him with heads place them in the farthest edge of the trench he makes, at about three inches distance from one another. As soon as the digger has gone once the breadth of the ridge he begins again at the other side, and digging as before covers

covers the roots last set, and makes the same room for the setters to place a new row, at the same distance from the first as from one another. Thus they go on 'till a whole ridge, containing commonly one rod, is planted; and the only nicety in digging is to leave some part of the first stratum of earth untouched to lie under the roots; and in setting, to place the roots directly upon their bottoms. Formerly when roots were very dear they did not plant them so thick as they do now; and they have always some regard to the size of the roots, placing the largest at a greater distance than the small ones. The quantity of roots planted in an acre is generally about 128 bushels, which according to the distances left between them as before assigned, and supposing them all an inch in diameter one with another, will amount to 392040 in number. From the time that the roots are planted 'till about the beginning of September, or later, there is no more labour about them; but as they then begin to spire and are ready to shew themselves above ground, which is known by digging up a few, the ground is carefully pared with a sharp hough, and the weeds, &c. raked into the furrows. Some time after this the saffron flowers appear, which are gathered as well before as after they are full blown, and the most proper time for it is early in the morning. The owners of the saffron get together a sufficient number of hands, who pull off the whole flowers and throw them into a basket, 'till all are gathered, which happens commonly about ten or eleven o'clock. Carrying them home they immediately spread them upon a large table, and fall to picking out the filamenta styli, or chives, and together with them a pretty long portion of the stylus itself. The rest they throw away as useless. Next morning they return into the field again, whether it be wet or dry weather, and so on daily, even on sundays, 'till the whole crop be gathered. The chives being all picked out of the flowers, they dry them on a kiln built upon a thick plank (that it may be moveable from place to place) supported by four short legs. The outside consists of eight pieces of wood about three inches thick, joined in form of a quadrangular frame, about twelve inches square at bottom on the inside, and twenty-two inches at top, and in perpendicular height. On the fore-side four inches above the plank is left a hole about eight inches square, through which the fire is put in. Over all are laid laths pretty close to one another, nailed to the frame already mentioned, plaistered over on both sides, as is also the plank at bottom very thick to serve for a hearth. Over the mouth lies a hair-cloth fixed on both sides of the kiln, and likewise to two rollers or moveable pieces of wood, which are turned by wedges or screws in order to stretch the cloth. Instead of the hair-cloth many use a network of iron-wire, with which the saffron dries sooner and with less fewel; but the difficulty of preserving it from burning makes the hair-cloth be preferred by the nicest driers. The kiln is placed in a light
part

part of the house, and they begin by laying five or six sheets of white paper on the hair-cloth, upon which they spread the wet saffron between two and three inches thick. This they cover with other sheets of paper, and over these lay a coarse blanket five or six times doubled, or a canvas pillow filled with straw; and after the fire has been lighted for some time the whole is covered with a board having a great weight upon it. At first they give it a pretty strong heat to make the chives sweat, as they express it; and in this, if they do not use a great deal of care, they are in danger of scorching and so of spoiling all that is on the kiln. When it has been thus dried for about an hour, they take off the board, blanket and upper papers, and take the saffron off from that that lies next it, raising at the same time the edges of the cake with a knife. Then laying on the papers again they slide in another board between the hair-cloth and under-papers, and turn both papers and saffron upside down, afterwards covering them as above. When the heat has been continued for an hour longer, they look to the cake again, free it from the papers, turn it, cover it, and lay on the weight as before. If nothing happens amiss during these first two hours they reckon the danger to be over; for they have nothing more to do but to keep a gentle fire, and turn their cakes every half hour 'till it be thoroughly dry; which requires full 24 hours. Towards the latter end of the crop when the chives come to be smaller, they sprinkle the cake with a little small beer, to make it sweat as it ought; and some think that using two linnen cloths next the cake, instead of the two innermost papers, may be of some advantage in drying; but this practice is followed as yet but by few. The fire may be made of any kind of fuel; but that which smoaks the least is best, and charcoal for that reason is preferred to any other.

What quantity of saffron a first crop will produce is very uncertain. Sometimes five or six pounds of wet chives are got from one rood; sometimes not above one or two, and sometimes not enough to make it worth while to gather and dry it. About five pounds of wet saffron go to make one pound of dry, for the first three weeks of the crop, and six pounds during the last week; and now the heads are planted very thick, two pounds of dried saffron may, at a medium, be allow'd to an acre for a first crop, and four and twenty pounds for the two remaining, the third being considerably larger than the second. In order to obtain these, they only hough, gather, pick and dry it every year in the same manner as before, without the addition of any thing new; except that they let cattle into the fields after the leaves are decay'd, to feed upon the weeds; or perhaps mow them for the same use.

About midsummer after the third crop is gathered the roots must all be taken up and transplanted. To take up the saffron heads, or break up the ground, as their term is, they sometimes plough it, some

sometimes use a forked kind of hough called a paddock, and then the ground is harrowed once or twice over; during all which time of ploughing, or digging and harrowing, fifteen or more people will find work enough to follow and gather the heads as they are turned up. These they carry home in sacks, and there clean or rase them. This labour consists in clearing the roots thoroughly from earth, and from the remains of old roots, old involucra, and excrescencies; and thus they become fit to be planted in new ground immediately, or to be kept for some time without danger of spoiling. The quantity of roots taken up, in proportion to those planted, is uncertain; but at a medium it may be said that allowing for all accidents from each acre may be had twenty-four quarters of clean roots, all fit to be replanted. The owners are sure to choose for their own use the largest, plumpest, and fattest roots, but they reject the longish pointed ones, which they call spickers or spickards; for very small round or flat roots are sometimes observed to flower.

This is the whole culture of saffron in the country above-mentioned. As to the charges or profits which may be supposed, one year with another, to attend this branch of agriculture, I have drawn up the following computation for one acre of ground, according to the price of labour in this county.

	l.	s.	d.
Rent for three years - - - - -	3	0	0
Ploughing three times - - - - -	0	18	0
Dunging - - - - -	3	12	0
Hedging - - - - -	1	16	0
Spitting and setting the heads - - - - -	1	12	0
Weeding, or paring the ground - - - - -	1	4	0
Gathering and picking the flowers - - - - -	6	10	0
Drying the flowers - - - - -	1	6	0
Instruments of labour for 3 years with the kiln, about - - - - -	0	10	0
Ploughing the ground once and harrowing twice - - - - -	0	12	0
Gathering the saffron heads - - - - -	1	0	0
Rasing the heads - - - - -	1	12	0
Total charge	23	12	0

This calculation is made upon the supposition, that an acre of ground yields twenty-six pounds of neat saffron in three years, which I stated only as a mean quantity between the greatest and the least; and therefore the price of saffron must be adjusted accordingly, which I think cannot be done better than by fixing it at 30 s. per pound; since in very plentiful years it is sold for twenty, and is sometimes worth between three and four pounds. At this rate twenty-six pounds of saffron are worth thirty-nine pounds, and the neat profits of an acre of ground producing saffron, will in three years amount to fifteen pounds

pounds thirteen shillings, or to about five pounds four shillings yearly. This, I say, may be reckoned the neat profit of an acre of saffron, supposing that all the labour were to be hired for ready money; but as the planter and his family do a considerable part of the work themselves, some of this expence is saved: that is, by planting saffron he not only may reasonably expect to clear about five pounds yearly per acre, but also to maintain himself and family for some part of each year; and it is upon this supposition only, that the result of other computations which have been made of the profits of saffron, can be said to have any tolerable degree of exactness; but the calculations themselves are undoubtedly very unaccurate. I have said nothing here concerning the charge in buying, or profits in selling the saffron heads, because in any large tract of ground these must at length always balance one another, while the quantity of ground planted yearly continues the same, which has been pretty much the case for several years past.

*A description
of a new fa-
mily of plants
called Oxy-
oides. By Mr.
Garcin.*

*n. 415. p. 377.
Sept. & c. 1730.*

Fig. 72.

Fig. 73.

XVIII. THE true characters which ought to distinguish this family from the oxys are, that the leaves are disposed by pairs along a rib without being terminated by an odd one, which makes them entirely resemble those of the tamarind; that they are all gathered together in an umbel on the top of a naked stalk; that they are not in the least degree acid, and that they shew as great a sensibility on being touched as the species of mimosa. The species of this genus are, I. *Oxyoides Javanica*, sensitiva, caule rubescente, hirsuto, flore minore, fig. 72. II. *Oxyoides Malabarica*, sensitiva, caule viridi, glabro, altiore, flore majore, fig. 73. The first species grows usually to the height of half a foot. It is composed of a naked stalk, ribs of leaves, and pedicles of flowers. Each of these parts is of equal length, usually three inches when they are full grown. The root, almost as long as the stalk, runs streight down, sometimes obliquely into the ground. It tapers from its neck which is of the same thickness with the stalk. It is set with small fibres a little waved and white, and giving rise to other pretty short filaments. The whole is whitish. The stalk arises sometimes streight, and sometimes crooked; sometimes wrinkled, and sometimes plain throughout its whole length, pretty downy, or rather hairy, and always reddish in some places. It is from a line and a half to two lines thick towards the top, and usually something less towards the bottom. It forms a button, or little head at the top, which gives rise to all the other parts of the plant; that is, to the ribs of the leaves and the pedicles of the flowers; which makes the whole tuft resemble an umbel. The ribs of the leaves grow 'till they equal the length of the stalk. They are about the thickness of the treble string of a violin, and equal throughout their whole length. They are a little downy like the stalk. The leaves occupy two thirds of the rib, that part which is next the stalk being

being naked. The first pair of leaves is the least, and the last pair always the largest, being commonly half an inch long, and the smallest not above half so long. They grow so near the rib that they seem to have no tail. Their base is always the broadest part of the whole rib and always parallel to the rib; the rest of the leaf bends itself a little forwards. The middle of their length is usually their narrowest part, and from thence they are gradually enlarged, and rounded at their extremities. The bases of all the pairs are almost of the same bigness, except the last, which has the breadth on one side only of the little nerve which traverses the leaf, to avoid incommoding itself with its neighbour; but to make amends, the leaves of this pair are broader than the others a little below their extremities, especially outwards. They are all traversed lengthwise by a fine nerve, always bent like the leaf on the side of the last pair. They are of a lively green on the inside and a little whitish on the outside. Their plain is garnished with a great number of very slender threads, almost imperceptible, but parallel, which grow also by pairs, and are placed at acute angles with their little common nerve, and grow smaller at the edge of their leaf. In short, their position and figure come pretty near to those of the tamarind: the number is usually from eight to ten pairs. They shut themselves up at sun-set, as it were to sleep, after the same manner with the leaves of the tamarind. The ribs are in number from two to three dozen; and the pedicles of the flowers are about a fourth part fewer: both the one and the other appear of different lengths, because the shortest are the youngest, but at last they usually grow to almost the same length with the first. The opening of the leaves is performed almost after the same manner with that of the top of the spikes of the species of heliotropium, unrolling like the tail of a scorpion. The ribs and the pedicles are a little hairy and are both of the same thickness. The flower, though it seems to be monopetalous, is not so, any more than the species of oxys which seem to be so too: agreeable to the principles of M. Vaillant, who has laid it down for a rule, that in all monopetalous flowers the chives grow from the sides of the flower, and that those in which they grow from the base of the embryo, or rather from the ovary, are always polypetalous. In short, if we examine them nicely, which no one has done 'till now, we may observe that these flowers have no anus at the base, but that the petals, which are always five in number, have their bases separated very distinctly one from another; and though they are reunited about the middle, which makes them look as if they were of one piece, yet they may be separated without tearing, fig. 73. The petals of our oxyoides are equal, they are from 3 lines to $3\frac{1}{2}$ long, and towards the extremity about a third part as broad as they are long. They are lightly cut in like a heart at their extremities. They are of a lemon colour, paler or deeper, ac-

cording to the moisture or heat of the season. Each of them has a small streak running through its middle lengthwise. They are covered by their empalement about two thirds of their height, and from thence they open in form of a bell. They are very tender, and last but the space of one morning. The empalement is one leaved: it is two lines high, and the half of this height makes the thickness of its base. It divides a little below the top into five lobes very sharp at their extremities, is pale-green, regular, and a little hairy. The chives grow from the base of the embryo, and are twice the number of the petals, five of them being higher than the other five, and reaching up to about the middle of the petals. Their summits are of the same colour with the petals, and the chives of the same with the empalement, or a little brighter. The ovary is very small and round, but a little furrowed into five ribs, the diameter of which is almost half a line. It is crowned by five teeth which form the body of the style. This ovary afterwards becomes a dry fruit, of an oval form, starred with five furrows, of which the least diameter is two lines. This fruit is divided into five cells, opens at the top when ripe, and expands itself by little and little to its very base, disclosing small, round seeds, lodged four together in each cell. They are each of them covered with a little hood, or very fine membrane, which on the encrease of the bulk of the seed opens with violence, and throws it on the ground. The colour of the seed pretty nearly resembles that of the seed of psyllium. Each pedicle during the time of its encrease continually puts forth new buds and new flowers, in the same manner as the stalk continually puts forth at the top new leaves and new pedicles. The number of these buds is usually five or six at the top of each pedicle, enlarged into a head. These buds grow, encrease and expand themselves one after another, which is the cause that this plant, when once it begins to flower, puts forth new flowers every morning which are quite vanished in the afternoon. The little bunches of buds, each of which adorns a large pedicle, are encompassed with little points which compose a kind of common empalement. The little pedicle which is proper to each flower is slender and a full line long, so that its length is equal to the diameter of the empalement. The diameter of the flower when most expanded is four lines. The petals make the empalement expand itself a little: but when the flower is faded the lobes of the empalement draw together and form a pyramidal body; but when the ovary grows bigger and becomes the fruit, the lobes of the empalement expand again without changing their shape; because the body of this empalement encreases its diameter by the effort which the fruit makes within it.

This plant is very sensible of the least cold, and loves warm, and moist places. It is found in Java, and probably in the other islands of the Sonde and the Moluccas. When one touches its leaves they close

close immediately, and open again by little and little. The more they are warmed by the sun, whilst their soil is moist, the more impetuously they close against one another. The Portuguese Indians call it *Dormidera*, because being touched it seems to sleep, by shutting up its leaves; or else because some among them think it procures sleep by being put under the ear, as I have seen practised; but I cannot ascribe this soporific quality to it. The leaves of this species of oxyoides have no acidity in their taste, and give but a faint tincture of red to blue paper.

Fig. 74, the flower of the oxyoides.

Fig. 74.

1. The empalement.
2. The flower, the petals of which are joined together.
3. A petal apart.

XVIII. 2. WE are obliged to M. Garcin for his curious description of this plant, by which its genus is determined. It is however by no means a new species, having been described long ago by Acoſta and other authors, under the name of *herba viva*. I have seen a fair specimen of it in Sir Hans Sloane's *hortus ficcus*, with which M. Garcin's figure agrees very exactly. It was the first sensitive plant known in Europe, and very different from those which are now brought from America, and cultivated in our gardens under that name.

A remark.
By Mr John
Martin. *ibid.*
p. 384.

XIX. ALMOST all the writers of botany have looked on this family as a tree on account of its bigness, though it is tender, spongy, membranous and succulent, not at all hard or woody. Its stalk is slender and supple, not able to keep itself upright, without a great number of thick, membranous sheaths which cloath its whole bulk and defend it from the injuries of the weather. Besides, this plant being annual bears fruit but once and then by degrees perishes. On the other side, ligneous, hard and perennial trees bear fruit several times. The bigness of a plant therefore does not seem to be a character sufficient to distinguish a real tree from a plant that is not one. Again, the same botanists have placed the *musa* in the palmaceous class, which are all trees, perhaps on account of this plant's having but one stalk without any branches; and because the great leaves at the top of it divide when they grow old, in such a manner as to resemble in some degree a sort of palm. Having had an opportunity in the Indies to consider this plant better, I soon found that it justly belonged to the liliaceous tribe. It is known that the liliaceous plants have several characters which distinguish them very well. Their roots are either bulbous, tuberous, or consisting of thick, fleshy fibres: their leaves involve the stalk, more or less at their bases. The substance of their flowers is filled with silver spangles; and lastly, their fruits are always divided into three cells. The *musa* has all these characters. F. Labat says in his travels, that the root of this plant is a thick bulb, round and massy, emitting fibres. Marcgrave, who

Remarks on
the family of
plants named
Musa. By
Mr. Garcin.
ibid. p. 384.

has given a full description of it under the name of *pacoeira*, has observed that at its first appearance it sends forth two or three leaves rolled up like a horn, which unroll themselves and grow after the manner of the *cannacorus*. And, according to my observation, the fruit in all its species is constantly divided into three cells, which is sufficient to shew that it is a true liliaceous plant.

As *Marcgrave* and the authors of the *Hortus Malabaricus* have largely described this plant, I shall content myself with only giving a definition of this genus to make it better known. The *musa* is a liliaceous plant, with a monopetalous, irregular flower, incompleat and hermaphrodite, composed of a tube which is filled with the ovary, and a pavilion divided into several lobes and forming a kind of mouth. The ovary, which adheres strongly to the tube, is triangular and crowned with five chives which grow from the sides of the flower; it has also a stile which is terminated by a little head. It afterwards becomes a soft, angular, long, crooked fruit, something like a cucumber. This fruit when ripe, is fleshy and divided into three cells filled with a mucilaginous pulp; under which the seed is placed along a placenta that serves as an axis to the fruit. This seed is small, round, edged with an almost imperceptible leaf. The flowers grow at the end of the stalk, in knots disposed in a spike. Each knot is loaded with two rows of flowers, covered with a membranous, hollow, thick, oval covering, which serves them for a common empalement. In the *Hortus Malabaricus* there are three plates which give a good representation of the plant, its flower, and its fruit; but I have observed three defects in them: 1. The flower is not represented in its most perfect state, but almost withered, and so its pavilion too much cleft, which makes the flower seem tetrapetalous; for the flowers of these plants divide when they are old, as well as the leaves. 2. The three cells are not shewn distinctly in the transverse section of the fruit. 3. The seed is not represented at all. This genus comprehends twenty or twenty-five species known to the Indians, the differences of which are usually taken from their fruits. The bark of the fruit is formed of the tube of the flower; and the lobes dry away during the growth of the fruit.

Fig. 75.

Fig. 75 represents the fruit of the *musa* entire.

1. The same half stripped of its bark.
2. Cut through the middle.
3. Cut transversely, distinguishing the three cells and the seeds.
4. Another species of *musa* cut transversely, represented in the *Hortus Malabaricus*, but having the cells better distinguished here. The six black points are the seed.

A description of the Cereus Peruvianus which flowered at Norimberg in 1730. XX. THIS *Cereus*, being separated from another of which it was a branch seven years ago, and exposed in open air all summer, grew with-

ed at Norimberg in 1730. By Dr. J. Trew, to Sir Hans Sloane, Bart. n. 416, p. 462. Nov. &c. 1730.

without pushing forth branches. It is six foot three inches high, and thirteen inches thick. It has seven angles at its basis, eight about the middle, and nine near the top. Its upper part is of a sea-green, on account of the powder with which it is covered; its lower of a grass-green. The down of its prickles is between pale and white about the top, every where else it is brown. Sept. 5, at the height of six foot two inches from the ground it shot a certain round knot from its trunk, which without any help of art so encreased and extended almost horizontally, that on the 14th of the same month it was eight inches long, and plainly shewed a flower as yet closed and embellished with a beautiful mixture of green, purple and white. The same evening the flower began to open, about midnight it was entirely spread to six inches in diameter. It was of a pretty strong, but not very pleasant smell. After midnight it gradually contracted about half an inch, and remained thus 'till next day at noon. Then it began to contract faster to half the diameter of the expanded flower, and the next morning it was quite closed and withered, but hung on the trunk 'till Sept. 30. The beginning of the flower was a sort of tube three inches long, not quite an inch thick, between a yellow and a pale green. Its surface was smooth, but channelled by certain small narrow furrows, between which blunt protuberances run in a parallel order along the ridges. Where the tube expanded itself it divided into more than forty petaloid segments, ranked in six separate series, the three inferior and exterior whereof here and there confounded their order, while the three superior and interior remained regular and unmixed. These series were distinguished by their size and colour. The first or exterior was of the same colour with the tube, viz. of a pale green; but its upper part gradually inclined to a purple. The second and third had half the inner part greenish, the edges of a more intense purple. The fourth was between yellow and white, terminating in purple tops. The tops of the fifth were likewise purplish. The petaloid segments of the sixth were very tender and white. The segments were of an oblong figure, and in the first series were terminated with blunt, in the others with more and more pointed tops. The inner or sixth series, which contained thirteen of these segments, exhibited all the edges finely and lightly, but irregularly cut and divided. The pistillum of equal height with the surface of the flower, and hollow like a small tube, ran at its upper end into as many fine pale filaments spread in the form of a crown, as there were segments in the inmost row, viz. thirteen. The day before the flower dropped from the ovarium, the place where it was to separate was marked by a blackish circle, at which the tube separated spontaneously from the ovarium or matrix, that is, the rudiments of the fruit; the pistillum still firmly adhering to the ovarium. The flower being dissected longitudinally, it manifestly appeared that the petaloid segments of
the

the flower, far from affording the least mark of a natural partition, stuck so very close to the tube that not one of them would quit it without violence.

Though the fruit came not to its full growth, yet it plainly appeared by inspection alone, that it is not prickly. Upon dissection it afforded a viscous juice, and within was a cavity, the sides whereof were every where, except at the bottom, thick set with innumerable small villi, to each whereof hung an oblong, white pellucid vesicle, which is the rudiment of the future seed.

Rare plants.

By Mr. J. Martin.

n. 407. p. 22.

Jan. &c.

1729.

XXI. In my way to the Peak in Derbyshire I took notice of the following plants, which I have not observed to be common in other parts of England, nor are they taken notice of by the bishop of London in his edition of Cambden.

Stachys Fuchii, J. B. In the road to Grantham, a little beyond Coleworth.

Scrophularia Scorodoniæ, folio mor. At Wollerton under the garden-wall. This does not owe its origin in this place to seeds scattered out of the garden; as I am convinced by the perusal of a manuscript catalogue of the plants cultivated in that garden, in which there is no mention made of this plant.

The *Lychnis* which grows on Nottingham-Castle is the *Lychnis sylvestris alba* of Clusii, and not the same with Mr. Ray's *Lychnis major noctiflora Dubrensis perennis*, as he suspected.

Festuca humilior panicula brevi heteromalla. *Gramen paniculatum, bromoides, minus, paniculis aristatis, unam partem spectantibus Raii Syn.* On Sherwood forest.

Salix folio laureo, seu lato glabro odorato Phyt. Brit. Common about Wingerworth.

Ladanum arvense, flore amplo luteo; labro purpureo. *Lamium cannabinum*, flore amplo luteo, labio purpureo Raii Syn. In the corn in several places.

Filix mas non ramosa, pinnulis angustis, raris, profunde dentatis Ger. emac. Common about Wingerworth.

The more rare plants which I observed in the Peak are,

Scariola sylvestris anguillaræ. *Lactuca sylv. murorum flore luteo* J. B. On old walls and about the entrance into Peak's-hole. It grows also in Hertfordshire. I take notice of it on this occasion because M. Vaillant has evidently mistaken the characters of it in his new distribution of the cichoraceous tribe in the memoirs of the royal academy of sciences for 1721. He there makes it a species of *lactuca*, from which it is very different on his own principles. According to his method the empalement of the *lactuca* is squamous, and the down of the seed sits upon a pedicle. But this species has a simple empalement and a sessile down. These characters evidently distinguish it not only from *lactuca*, but from every genus in his method.

thod. I shall take leave therefore to constitute a new genus: and as the name of Scariola, by which Anguillara has called it, has not yet been appropriated to any other genus, I shall appropriate it to this, and define it as follows;

Scariola is a cichoraceous plant, with a simple empalement, a naked placenta, and seeds crowned with a hairy sessile down.

Rosa sylv. alba cum aliquo rubore foliis hirsutis J. B. In several hedges about Hathersedge.

Empetrum montanum fructu nigro Tourn. Common on the mountains.

Oxycoccus, seu vaccinia palustris, J. B. On boggy places, but not very common.

Erica humilis cortice cinereo arbuti flore albo, H. R. Par. On the mountains near Hathersedge.

Rubus Idæus spinosus fructu rubro, J. B. In the hedges.

Geranium saxatile Ger. emac. About the entrance into Peak's-hole.

Cochlearia rotundifolia minima Merr. With the preceding.

Thalictrum minus Ger. In the same place.

Lichenoides saxatile, fuscum, pilosum, varie divisum. Corallina fusca foliosa Doody Budd. Hort. sic. On the rocks.

Lichenoides saxatile tinctorium foliis pilosis purpureis Dillenii. On the rocks.

Ufnea saxatilis, capillacea. Muscus corallinus, saxatilis, foeniculaceus Raii Syn. On the rocks near Darwent.

Lycopodium Sabinæ facie Fl. Jen. On the mountains near Darwent.

Selago foliis & facie Abietis Fl. Jen. On the mountains near Darwent.

Bryum hypnoides capitulis, plurimis erectis lanuginosum Dillenii. On the mountains.

Cardamine impatiens altera hirsutior Raii Syn. About the mouth of Pool's-hole plentifully.

A variety of Mr. Ray's Viola montana lutea, with a blue and yellow flower.

XXII. THE company of Apothecaries of London having, in the year 1673, established a physic-garden, which they have since furnished with a great variety of plants for the improvement of their members in the knowledge of botany; Sir Hans Sloane Bart. in order to encourage and promote an undertaking so serviceable to the public, has generously granted to the company the inheritance of the said garden, being part of his estate and manor of Chelsea, on condition that it be for ever kept up and maintained by the company as a physic-garden; and as an evidence of its being so maintained he has directed and obliged the company, in consideration of the said grant,

An alphabetical catalogue of plants presented to the Royal Society by the company of Apothecaries of London.

to

to present yearly for ever to the royal society at one of their weekly meetings, fifty specimens of plants that have grown in the said garden the preceding year, which are all to be specifically distinct from each other, until the number of 2000 plants be compleated. Accordingly the company did present to the royal society the following specimens of plants, which together with those that are to follow them in subsequent years will, by order of the royal society, be carefully preserved for the satisfaction of such curious persons as may desire to have recourse to them. The numbers prefixed show the order in which they were presented.

N°

- 201 **A** BUTILON, Dod. 656.
 202 ——— Americanum, fructu subrotundo pendulo, e capsulis
 vesicarijs crispis conflato.
 51 ——— Carolinianum, reptans, alceæ folijs, gilvo flore.
 351 Acer fraxini folijs, ferratis. Acer maximum; folijs trifidis et quin-
 quefidis, Virginianum. Pluk. Phyt. tab. 123. fig. 4, 5.
 251 Acetosa ocimi folio, Neapolitana, C. B. 114.
 252 ——— vesicaria peregrina, Hort. Eyst.
 354 Agrimonia minor; flore albo, H. C. Boerh. Ind.
 352 ——— odorata. Cam. Hort.
 353 ——— officinarum. T. Inst. 301.
 253 Alcea Afra, frutescens, grossulariæ folio; flore parvo rubro
 Boerh. Ind. alt. 271.
 254 ——— folio ampliore; unguibus florum atro-rubentibus.
 152 Alchimilla Alpina, pubescens, minor, H. Reg. Par.
 255 ——— montana minima Colum. Ecphr. 146.
 151 ——— vulgaris, C. B. 319.
 203 Alkekengi Barbadense, patulum, flore parvo; fructu amplo mu-
 crone productiori.
 205 ——— Curaçavicum; folijs origani incanis; flore viète sulphureo,
 fundo purpureo, Boerh. Ind. alt. II. p. 66.
 204 ——— Indicum majus, T. Inst. 151.
 206 ——— Verticillato simile; folijs angustioribus, utrinq; acuminatis.
 207 ——— Virginianum perenne majus; flore luteo amplo; fructu
 minimo.
 258 Althæa arborea, folio amplo, serrato.
 259 ——— Dioscoridis & Plinij, C. B. 315.
 260 ——— Dioscoridis & Plinij, folio magis angulato. T. Inst. 97.
 257 ——— frutescens, bryoniæ folio. C. B. 316.
 256 ——— frutescens, folio acuto; parvo flore, C. B. ib.
 53 Alysson veronicæ folio. T. Inst. 217. Bursa pastoris major loculo
 oblongo. C. B. prod.
 261 Ambrosia gigantea, inodora; folijs asperis trifidis Banist. Cat.
 Raij Hist. ap. 1928.

- 52 *Ambrosia maritima*, *artemisiæ folijs inodoris*, *elatior*. H. L. Bat.
 208 *Ammi perenne* Moris, Umb. 22.
 355 *Anapodophyllon Canadense* Morini. T. Inst. 239.
 1 *Anemone Virginiana*, *tertiæ Matthioli similis*, *flore parvo*. Par.
 Bat. 18.
 301 *Anonis Americana*; *folio latiori*, *subrotundo*. T. Inst. 409.
 302 *Apocynum frutescens*; *falicis folio angusto*.
An Apocynum erectum, *Africanum*; *villosa fructu*, *falicis folio*,
glabro, *angusto*. Par. Bat. 24?
 209 — *scandens*, *Africanum*; *convolvuli minoris folio & caule*
hirsutis, Pluk. Phyt. tab. 137. fig. 4.
 356 *Apocynoides subhirsuta*; *floribus aurantijs*.
 357 *Aracus*, q. *vicia segetum*; *singularibus filiquis glabris*. C. B. 345.
 262 *Asperugo vulgaris*. T. Inst. 135.
 153 *Aster Americanus belvideræ folijs*, *floribus ex cæruleo albican-*
tibus, *spicis prælongis*. Pluk. Phyt. tab. 78. fig. 5.
 303 — *Americanus*, *serotinus*, *altissimus*; *folio brevi*, *caulem*
amplectente.
 156 — *maritimus flavus*, *crithmum chrysanthemum dictus*,
 Raij Hist. 268.
 55 — *montanus*, *falicis glabro folio*. C. B. 266.
 54 — *peregrinus*, *cisti folio non crenato*, *flore magno*, *luteo*.
 Pluk. Phyt. tab. 16. fig. 2.
 155 — *pyramidatus*, *hyssopi folijs*, *asperis*, *calycis squamulis foliaceis*.
 154 — *Virginianus*, *angustifolius*, *serotinus*, *parvo albente flore*,
 Park. Th. 132.
 263 *Barba jovis*, *Caroliniana*, *arborescens*; *pseudo-acaciæ folijs*,
bastard indigo, *incolis*.
 2 *Bellis Africana*, *capitulo aphylo luteo*, *coronopi folio*, *caulibus*
procumbentibus. H. L. Bat.
 304 *Betonica maxima*; *scrophulariæ folio*; *flore e luteo pallescente*
 Schol. Bot. 64.
 305 — *maxima*, *scrophulariæ folio*; *floribus incarnatis*. Par.
 Bat. 106.
 210 *Bidens Americana apij folio*; T. 462.
 211 — *Americana nodiflora folijs latis acuminatis*. *Chrysan-*
themum conyzoides, *nodiflorum*; *semine rostrato bidente*,
 Sloane Hist. Vol. I. p. 62. tab. 154. fig. 4.
 212 — *Caroliniana*, *florum radijs latissimis*, *insigniter dentatis*; *semine*
alato, *per maturitatem convoluta*.
 56 — *Indica*, *hieracij folio*, *caule alato*. T. Inst. 462.
 58 *Blitum quod amaranthus Græcus*, *sylvestris*, *angustifolius*.
 T. Cor. 17.
 57 — *monospermum*, *Indicum*, *aculeatum*. Breyn. prod. 18.

- 358 *Brassica orientalis*, perfoliata ; flore albo ; siliqua quadrangula.
T. Cor. 16.
- 157 *Brunella Caroliniana*, magno flore, dilute cæruleo ; internodijs prælongis.
- 359 ——— laciniata ; flore elegantissimè sulphureo. Boerh. Ind. alt. 169.
- 158 ——— N. Angliæ major ; folijs longius mucronatis.
- 213 *Buglossum Lusitanicum*, bullatis folijs Moris. Hort. Blæs.
- 3 Bupleurum angustifolium. Dod. 633.
- 4 Calamintha, magno flore. C. B. 229.
- 59 *Calcitrapoides pumila*, supina, tenuifolia, calyce turbinato. D. Vaillant. Act. Ac. Par.
- 214 *Caltha Africana*, flore intus albo foris violaceo, T. Inst. 499.
- 215 *Cardamine impatiens*, vulgo sium minus impatiens, Gerard.
- 216 ——— impatiens altera hirsutior, Raij Synops.
- 5 *Carduus capite rotundo tomentoso*. C. B. 382.
- 264 *Carlina patula*, atracylidis folio & facie. T. Inst. 500.
- 60 *Cassia decaphylla*, orobi Pannonici folijs mucronatis.
- 360 *Cassida Cretica* ; fruticosa ; catariæ folio ; flore albo. T. Cor. 11.
- 362 ——— orientalis ; chamædryos folio ; flore luteo. T. Cor. 11.
- 361 ——— palustris, vulgatior ; flore cæruleo. T. Inst. 182.
- 64 *Cataria Hispanica*, betonicæ folio angustiori, flore albo. T. Inst. 202.
- 66 ——— quæ horminum spicatum, lavendulæ flore & odore. Boccon. rar. 48.
- 65 ——— Lusitanica, erecta, betonicæ folio ; tuberosa radice. T. Inst.
- 61 ——— major vulgaris. T. Inst. 202.
- 62 ——— minor angustifolia. Ib.
- 63 ——— quæ nepeta Pannonica major & elatior.
- 67 ——— orientalis, teucrij folio, lavendulæ odore, verticillis florum crassissimis. T. Cor. 13.
- 159 *Caucalis Hispanica*, Cam. Hort. 37. fig. 11.
- 265 *Centaurium folijs cynaræ*. Cornut. 72.
- 306 *Chamædryos* ; vulgo vera existimata. J. B. 3. 288.
- 307 ——— folijs parvis leniter crenatis.
- 308 ——— frutescens ; teucrium vulgo. T. Inst. 205.
- 309 ——— laciniatis folijs. Lob. Icon. 385.
- 310 ——— quæ teucrium Hispanicum, supinum ; verbenæ tenuifoliæ folijs. D. Goiffon. D. Jussieu.
- 6 *Chrysanthemum perenne*, minus, falicis folio glabro. H. Ox. p. 3. 21.
- 68 ——— tenuifolium flore bullato aureo. Barrel. ic. 450.
- 69 ——— flore luteo, aphylo minore. Ib. 452.
- 266 *Circaea Lutetiana*. Lob. Icon. 266.
- 267 ——— minima. Colum. Ecphr. 80.

- 7 *Cirsium altissimum*, albis maculis notatum, semine viscoso. *Carduus* albis maculis notatus, capitulis *cirsij*. Schol. Bot. 215.
 70 ——— humile, ramosum, folijs integris.
 8 *Clematitis cærulea erecta*. C. B. 300.
 9 ——— *f. flammula surrecta alba*. J. B. 2. 127.
 217 ——— *peregrina folijs pyri incis.* G. B. 300.
 10 *Cnicus perennis cæruleus*, *Tingitanus*. H. L. Bat. 162.
 219 *Coma aurea Africana fruticans*, folijs *crithmi marini*. H. Amst. 2. 99.
 311 *Commelina graminea, latifolia*; flore cæruleo. Plum. N. Gen. Plant.
 363 *Convolvulus Canariensis*; longioribus folijs, mollibus & incanis. Pluk. Phyt. tab. 325. fig. 1.
 268 *Conyza Africana, frutescens*; folijs *salviæ*; odore *camphoræ*. T. Inst. 455.
 11 ——— *Africana, senecionis flore, retusis folijs*. H. L. Bat.
 312 ——— *orientalis, humilis*; *verbasci folio, candidissimo*.
An conyza tomentosa & candidissima; subrotundo, crasso folio; flore luteo. D. Sherard. Ac. Reg. Sc. Par. 1719?
 218 *Corchorus sive melochia*. J. B. 2. 982.
 160 ——— *Americana, prælongis folijs, capsula striata, subrotunda, brevi*, Pluk. Phyt. tab. 255. fig. 4.
 12 *Corona Solis altissima, alato caule*. T. Inst. 490.
 161 ——— *Caroliniæ, parvis floribus, folio trinervi amplo, aspero, pediculo alato*.
 162 ——— — *Rapunculi radice*, T. Inst. 490.
 313 ——— —; *Trachelij folio; radice repente*, T. Inst. 490.
 314 ——— —; *Trachelij folio, ramosior; radice non repente*.
 315 ——— —; *Trachelij folio, tenuiore; calyce floris foliato*.
 13 *Coronilla maritima glauco folio*. T. Inst. 650.
 316 *Cotinus coriaria*. Dod. 780.
 14 *Cucubalus Plinij*. Lugd. 1429.
 15 *Daucus fœniculi folijs tenuissimis*. C. B. 150.
 16 ——— *maritimus lucidus*. T. Inst. 307.
 364 ——— *qui pastinaca oenantes folio*. Boccon. rar. 75.
 17 *Dens leonis, folijs erysimi vulgaris*. T. Cor. 35.
 163 *Dictamnys Creticus*. C. B. 222.
 317 *Doria major, repens. Virga aurea maxima; radice repente; sive doria major, repens*. D. Bobart. Hist. Ox. 3. 123.
 318 ——— —; folijs tenuiter serratis, ad caulem latis.
An Alisma Monspeliensium; sive doria. J. B. 2. 1064?
 319 ——— —; *quæ Jacobæa, orientalis; limonij folio*. T. Cor. 36.
 164 *Dorycnium Monspeliensium*, Lob. Icon. 2. 51.
 365 *Echinopus minor, annuus, magno capite*. T. Inst. 463.
 320 *Elatine; folio acuminato in basi auriculato; flore luteo*. C. B. 253.
 H h 2 321 *Elatine;*

- 115 *Geranium batrachoides odoratum*. C. B. 318.
 116 — *Annuum minus batrachoides*, Bohemicum, purpuro-violaceum. H. Ox. p. 2. 511.
 117 — *Phæum*, flore reflexo. I. B. T. 3. 477.
 118 — *Magnum*, folio trifido. I. B. T. 3. 478.
 119 — *Romanum versicolor*, sive striatum. Park. Parad. 229.
 120 — *Robertianum primum*. C. B. 319.
 121 — — *Rubens*, flore albo.
 122 — *Lucidum*, faxatile, foliis geranii Robertiani. D. Sherard. Raij Syn. 218.
 123 — *Folio althææ*. C. B. 318.
 124 — — — *Floribus saturatiùs rubentibus*. H. L. Bat. 290.
 125 — *Chium vernal*, caryophyllatæ folio. T. Cor. 20.
 126 — *Folio alceæ*, tenuiter laciniato; flore pentapetalo; purpurascens, semine tenui. Boerh. Ind. alt. 266.
 127 — *Cicutæ folio*, moschatum. C. B. 319.
 128 — — — *Minus & supinum*. C. B. 319.
 129 — *Arvense*, album. Tabern. Ic. 57.
 130 — *Myrrhinum*, tenuifolium, amplo flore purpureo. Barrel. ob. 55.
 131 — *Latifolium*, longissimâ acu. C. B. 319.
 132 — *Cicutæ folio*, acu longissimâ. C. B. ibid.
 133 — *Acu longissimâ*, cicutæ folio tenuius laciniato.
 — *Cicutæ folio*, viscosum, acu longissima. D. Jussieu.
 134 — *Triste Cornuti*. 109.
 135 — *Æthiopicum*, noctu olens, radice tuberosa, foliis myrrhidis, angustioribus, Breyn. Cent.
 136 — *Africanum*, coriandri folio, floribus incarnatis, minus. H. L. Bat. 279.
 137 — *Africanum frutescens*, chelidonii folio, petalis florum angustis, albidis; carnoso caudice.
 138 — — *Noctu olens*, tuberosum & nodosum, aquilegiæ folijs. H. L. Bat. 284.
 139 — — *Betonicæ folio*, procumbens, floribus parvis, eleganter variegatis. Pluk. Alm. 169.
 140 — — *Foliis inferioribus asari*, superioribus staphydis agriæ, maculatis, splendentibus, & acetosæ sapore. Com. Præl. 52.
 141 — *Africanum frutescens*, folio crasso & glauco; acetosæ sapore. Com. Præl. 54.
 142 — — *Alchimillæ hirsuto folio*, floribus albidis. H. L. Bat. 282.
 143 — — *Folio malvæ crasso*, molli, odoratissimo, flosculo pentapetalo, albo. Boerh. Ind. alt. 263.
 144 — — *Frutescens*, malvæ folio laciniato, odorato. H. L. Bat. 277.
 145 — — — — *Instar melissæ*, flore purpurascens. Boerh. Ind. 110.

146 — — — *Arbo-*

- 146 *Geranium Africanum* arborescens, malvæ folio, mucronato, petalis
florum inferioribus vix conspicuis.
- 147 — — — *Alchimillæ* hirsuto folio, floribus rubicundis. Com.
Præl. 51.
- 148 — — — Folio malvæ plano, lucido, glabro; flore kerme-
fino, Di van Leur. Boerh. Ind. 109.
- 149 — — — Ibisci folio rotundo; carlinæ odore. H. L. Bat. 274.
- 150 — — — Anguloso; floribus amplis purpureis.
— — — Frutescens, alchimillæ folio, hirsuto, cum fimbriis pur-
pureis. Boerh. Ind. 110.
- 170 — — — *Cicutæ* folio, erectum, Romanum. Bocc. Mus. p. 2. 93.
- 171 — *Columbinum* erectum, Carolinianum, floribus purpurascens.
- 324 — *Ægyptiacum*; althææ folio, subtus glauco. Lipij. D. Jussieu.
- 325 — *Alpinum*; coriandri folio, longius radicum; flore purpu-
reo. D. Micheli Hort. Pisan. 68.
- 271 *Glycyrrhiza* capite echinato. C. B. 352.
- 21 *Gnaphalodes* Lusitanica. T. Inst. 439.
- 272 *Gramen* dactylon, majus; panicula longa; spicis plurimis nudis,
crassis. Sloane Hist. V. 1. 112. tab. 69. fig. 2.
- 293 — — —, panicula longa; e spicis plurimis glaucioribus, pur-
pureis, mollibus constante. Sloane Hist. V. 1. 113. tab. 70. fig. 2.
- 368 *Hedypnois* annua. T. Inst. 478.
- 369 — — — *Cretica*, minor, annua. T. Cor. 36.
- 370 — — — *Hispanica*, procumbens, magno capite.
An *Hedypnois* annua, capite maximo, Boerh. Ind. alt. 93?
- 371 *Heleniastrum*, folio longiore & angustiore. D. Vaillant. Acad.
Reg. Par. Ann. 1720.
- 372 — — — serius florens; latiore folio; ramosissimum.
An *Heleniastrum*; folio brevioris & latioris, Ejusd. ibid?
- 71 *Helianthemum* Anglicum, vulgari simile, flore stellato.
- 72 — — — ampliore folio, flore roseo. D. Sherard.
- 73 — — — *Halimi* folio, angustiore, acuto.
An *Cistus* halimi folio, 2 Clus. Hist. 71.
- 274 *Heliotropium* Americanum, cæruleum; folijs hormini. Dodart
Mem. 83.
- 275 — — — majus *Dioscoridis*. C. B. 253.
- 172 *Hermannia* frutescens, folijs oblongis, ad apices solummodo ser-
ratis.
- 326 — — — frutescens; folio ibisci, hirsuto, molli; caule piloso.
Boerh. Ind. 1. 115.
- 327 — — —; alni folio parvo.
An *Ketmia* Africana, fruticans & erecta; alni folijs latioribus
& majoribus; flore spirali sulphureo. Hort. Amst. p. 2. 155?
- 328 — — —; minimo alni folio.
An *Ketmia*, &c. folijs triplo minoribus. ibid?
- 74 *Hieracium* Pyrenaicum blattariæ folio minus hirsutum. Schol. Bot.
- 75 *Hiera-*

- 75 *Hieracium castoreiodore nostras. Hieraceum cichorej, vel potius stæbes folio, hirsutum. Raij Cat. Cant.*
- 373 ——— fruticosum; angustissimo, incano folio. H. L. Bat. 316.
- 374 ——— *Pulmonaria dictum, latifolium, humilior; ramulis expansis.*
- 22 *Horminum sylvestre, latifolium, verticillatum. C. B. 238.*
- 23 *Hypericum perforatum & perforatum. T. Inst. 255.*
- 24 *Jacea altissima, folio dissecto, capite ovarij nudo. D. Vaillant.*
- 25 ——— *Lusitanica, semper virens. H. Reg. Par.*
- 276 ——— cum squamis pennatis, five capite villoso. J. B. 3. 28.
- 26 *Jacobæa perennis asplenij folio. D. Vaillant.*
- 173 ——— *Africana, frutescens, flore amplo purpureo elegantissimo, fenecionis folio. Volk. Flor. Norimb.*
- 174 ——— *Sicula, chrysanthemii facie. Bocc. Rar. p. 66.*
- 329 ——— *Hispanica, minus laciniata; petalis brevissimis. T. Inst. 486.*
- 330 *Jasminum Arabicum; castaneæ folio; flore albo, odoratissimo; cujus fructus Coffy in officinis. Boerh. Ind. alt. 217.*
- Arbor *Yemensis fructum Cofé ferens. D. Douglas.*
- 220 *Kali spinosum; folijs longioribus & angustioribus, T. Inst. 247.*
- 221 ——— folijs crassioribus & brevioribus, *ibid.*
- 277 *Ketmia Syrorum quibusdam. C. B. 316.*
- 222 *Lactuca Canadensis, altissima, latifolia; flore leucophæo. T. Inst. 474.*
- 375 *Lamium Garganicum, subincanum; flore purpurascens, cum labio superiore crenato. Micheli Hort. Pisan. 93. tab. 32.*
- 376 ——— orientale, argentatum, annuum; flore albo.
- moschatum foliorum marginibus argentatis. *Wheeleri Itin.*
- 377 ——— purpureum, perenne; folijs acutis, profunde incis. ———; folio oblongo; flore rubro. *Park. Theat. 606.*
- 223 *Lathyrus sylvestris major flore minore; folijs longius mucronatis.*
- 224 *Lavandula folio dissecto. C. B. 216.*
- 278 *Linaria capillaceo folio. C. B. 213.*
- 279 ——— cærulea, folijs brevioribus & angustioribus. *Raij Syn. Ed. 3. 282.*
- 331 ——— vulgaris lutea; flore majore. *C. B. 212.*
- 332 ——— lutea elatior & ramosior; flore minori.
- 333 ——— *Hispanica, procumbens; folijs uncialibus, glaucis; flore flavescente, pulchrè striato, labijs nigro-purpureis.*
- 334 ——— multicaulis, erecta annua; angusto molluginis folio; floribus luteis rarè dispositis.
- 27 *Lotus pentaphyllus minor hirsutus, filiqua angustissima. C. B. 332.*
- 38 *Lunaria vasculo sublongo intorto. Raij Syn. 164.*
- 175 *Lychnidea Virginiana, holostei ampliore folio, floribus umbellatis, purpureis.*
- 29 *Lychnis linifolia torosis & laxioribus capitulis. Bar. Obs. 64.*

- 76 ——— or. longifolia, nervosa, flore purpurascente. T. Cor. 24.
 225 ——— Hispanica major latifolia flore albo.
 226 ——— Maritima repens, C. B. 205.
 227 — — Anglica, amplioribus folijs.
 228 ——— Orientalis bupleuri folio, T. Cor. 24.
 229 ——— — Calyce pyramidato, striato, longissimo; T. Cor. ib.
 230 ——— — Folijs carnosis; caule ramosissimo; flosculis minutis onusto.
 ——— Orient. saponariæ folio & facie, flore parvo & multiplici. T. Cor.
 231 ——— Frutescens, myrtifolia, been albo similis, C. B. 205.
 232 ——— Segetum meridionalium annua, hirsuta; floribus rubris, uno versu dispositis, Boerh. Ind. Alt. 214.
 233 ——— Sylvestris viscosa rubra angustifolia, C. B. 205.
 234 ——— —, Viscosa, rubra altera, ib.
 235 ——— Umbellifera, montana, Helvetica, Zanon. 128.
 378 ——— Hispanica; folio kali; multiflora. T. Inst. 338.
 236 Lyfimachia bifolia flore globofo, C. B. 245.
 30 Majorana Cretica, origani folijs, villosa, satureiæ odore, corymbis majoribus albis. T. Cor. 13. Origanum Smyrnæum Wheeleri.
 77 Malva Sinensis, annua, erecta, flore minimo, Ki tsai tsè dicta.
 78 ——— Lusitanica, annua, flore parvo striato.
 79 ——— Sylvestris, folijs sinuatis minoribus, flosculis minimis, Anglica. Boerh. Ind. 2. 268.
 80 ——— or. erecta, major, flore vix conspicuo. D. Sherard.
 81 ——— or. erectior, flore magno, suave rubente. T. Cor.
 82 ——— Syriaca, Ela haur taunal dicta. Malva Cretica, annua, altissima, flore parvo ad alas umbellato. T. Cor. ib.
 237 Malvinda ulmifolia, semine rostrato.
 Malva annua fruticosa Pernambucana flore luteo, Zanon 132.
 238 ——— — Semine bidente.
 Malva ulmifolia, semine cum gemino rostro, T. Inst. 96.
 239 ——— Pimpinellæ majoris folio semine bidente.
 240 ——— — Folio augustiori semine bidente.
 241 Malvinda, profundius serrato folio, semine tridente.
 242 ——— Abutili folio, flore luteo spicato.
 Althæa Indica abutili subrotundo folio, flore luteo spicato, Pluk. Phyt. tab. 74. fig. 6.
 243 ——— —; flore luteo spicato minor.
 31 Marrubium Hispanicum supinum, folijs sericeis argenteis. T. Inst. 192.
 176 ——— album, folijs amplis, fere circinatis.
 386 Mentha sisymbrium dicta, hirsuta, rotundifolia; odore aurantij D. Manningham.
 Mentha, sisymbriuin dicta, hirsuta; glomerulis & folijs minoribus ac rotundioribus. Raij Syn. Ed. 233.
 379 Millefolium, vulgare, album. C. B. 140. 380 Mille-

- 380 *Millefolium album*, incanum ; segmentis foliorum latioribus.
 381 *Millefolium nobile* Tragi. 476.
 382 *Millefolium*, odoratum, Monpeliense. Pillet. 271.
 383 *Millefolium*, minus, tenuifolium ; tanacetii odore. Barrel. Obs.
 N°. 1117.
 384 *Millefolium*, tomentosum, luteum. C. B. 140.
 385 *Millefolium* ; foliis sophiæ fere divisura ; floribus parvis, ex albo flavescentibus.
 83 *Mimosa Jamaicensis* Zanon. Hist. 149.
 244 *Meldavica betonica* folio flore cæruleo. T. Inst. 184.
 245 ————— *orientalis*, *betonica* folio flore magno violaceo,
 T. Cor. 11.
 177 *Myosotis Hispanica* segetum, T. Inst. 245.
 178 ————— *orientalis* perfoliata, *lychnidis* folio, T. Cor. 18.
 246 *Myrrhis tuberosa*, nodosa, *coniophyllon* Moris. Umb. 67.
 247 ————— folio *podagrariæ* Rivin.
 387 ————— trifolia, *Canadensis*, *angelicæ* facie. T. Inst. 315.
 248 *Niruri Barbadense*, folio ovali subtrus glauco, pediculis florum brevissimis.
 336 *Parietaria officinarum* & *Dioscoridis*. C. B. 121.
 337 ————— *vulgaris*, *anglica*. *Parietaria minor*, *ocymi* folio,
 C. B. *ibid*.
 338 *Partheniastrum americanum* ; *ambrosiæ* folio. Ac. Reg. Sc. Par.
 32 *Pentaphylloides palustre rubrum*. T. Inst. 298.
 33 *Pentaphylloides fruticosa*. Raij Syn. 142.
 179 *Pentaphylloides erectum*, J. B. 2. 398.
 180 ————— *Canadense*, folio *agrimoniæ*. *Sarracen*. D. Vaillant.
 181 ————— *Fragariæ* folio, Bot. Monsp. App. 309.
 182 ————— & *crenis obtusioribus*.
 283 *Perfoliata vulgarissima*, sive *arvensis*. C. B. 277.
 280 *Perficaria mitis*. J. B. 3. 779.
 281 *Perficaria mitis major* ; foliis pallidioribus. D. Bobart. Raij Syn.
 Ed. 2. 58.
 282 *Perficaria orientalis*, *nicotianæ* folio ; calyce florum purpureo.
 T. Cor. 38.
 34 *Phlomis fruticosa*, *salviæ* folio latiore & rotundiore. T. Inst. 177.
 35 ————— *fruticosa*, *salviæ* folio longiore & angustiore. T. Inst.
 187 ————— *fruticosa*, *humilis*, *latifolia*, *candidissima* ; floribus
luteis.
 36 ————— *orientalis lutea*, *angustifolia cymis fulvescentibus*. D. Sherard.
 188 ————— *orientalis*, *lutea*, *herbacea*, *latifolia*, *verticillata*.
 37 ————— *Samia herbacea*, *lunariæ* foliis. T. Cor. 10.
 388 *Pimpinella sanguiforba major*. C. B. 160.
 389 ————— *major*, *rigida*, *præalta*, *auriculata*, *Sabauda*. Boccon.
 Mus. p. 19.
 VOL. VI. PART II. I i 284 *Portulaca*

- 284 *Portulaca Corassavica* procumbens; capparidis folio; flore muscoso; capsula bifurcata. Parad. Bat. 213.
- 38 *Parmica orientalis* pinnulis cristatis. T. Cor. *Ablinthium Santonicum Aegyptium*. C. B. 319.
- 39 *Quinquefolium album* majus alterum. C. B. 325.
- 183 ——— rectum luteum. C. B. ibid.
- 184 ——— quod pentaphyllum, seu potius heptaphyllum rectum; caule rubro, hirsutius, H. Cath. Boerh. Ind. 2. 40.
- 185 ——— minus, flore pallide luteo. T. Inst. 297.
- 186 ——— folio argenteo, C. B. 325.
- 285 *Ranunculus hirsutus*, annuus; flore minimo. Raij Syn. Ed. 2. 135.
- 84 *Rhagadiolus alter*. Cæsalp. 511.
- 85 ——— *lampsanæ* folijs. T. Cor. 36.
- 390 *Ribes fructu parvo*. Merret. Pin. Raij Syn. Ed. 3. 456.
- 391 ——— *Americana*; fructu nigro minimo; calyce floris campaniformi.
- 286 *Ricinus minor* staphyos agriæ folio; flore pentapetalo purpureo. Sloane Hist. Vol. I. 129. Tab. 84.
- 339 *Ricinoides arbor*, *Americana*; folio multifido. T. Inst. 656.
- 41 *Rubus odoratus*. Cornut. 150.
- 40 *Ruta Chalepensis*, latifolia, florum petalis villis scatentibus. H. L. Bat. 431.
- 86 *Salvia* or. *ablinthium* redolens, folijs pinnatis, flore carneo, elatior. D. Sherard.
- 290 *Santolina* folijs teretibus. T. Inst. 460.
- 291 ——— repens & canescens. ibid.
- 292 ——— folijs minus incanis. T. Inst. 461.
- 293 ——— folijs obscure virentibus. ibid.
- 294 ——— vermiculata *Cretica*. ibid.
- 295 ——— incana; *chamæmeli* odore suaviore. Boerh. Ind. alt.
- 123.
- 296 ——— tota viridis; folijs ericæ aut sabinae.
- An 3 Dodon. 269?
- 297 ——— canescens folijs cupressi.
- An 4. Dodon. ib.?
- 298 ——— minor candidissima.
- 340 *Satureia montana*. C. B. 218.
- 341 ——— montana; latiore folio; ramulis minus erectis.
- 87 *Scabiosa annua*, centauroides fistulosa. H. Cath.
- 88 ——— altissima, annua, folijs agrimonie nonnihil similibus. H. L. B. 539.
- 42 *Sclarea orientalis*, *betonica* folio aculissimo, coma purpurascens. T. Cor. 10.
- 189 ——— rugoso, verrucoso & laciniato folio, T. Inst. 180.
- 342 ——— folio *salviæ*, minor, sive glabra. T. Inst. 180.
- 343 ——— folio triangulari; caule tomentoso. ib. 392 *Sclarea*

- 392 *Sclarea Africana*; amplissimo folio; annua. Boerh. Ind. alt. 165.
 43 *Securidaca lutea major*. C. B. 348.
 289 *Sena spuria*, arborea, spinosa; folijs alatis ramosis, seu decompositis; flore ex luteo & rubro specioso. Sloane Hist. Vol. II. 49.
 190 *Senecio Ægyptius*, folio matricariæ, Boerh. Ind. i. p. 40.
 249 — *Virginianus*, arborescens, atriplicis folio. Par. Bat. 225.
 193 *Serratula annua*, seminibus nitidissimis ad basin compressis.
Senecio carduus Appulus, Col. p. 1. 32.
 194 — majoribus & minime compressis.
Crupina Belgarum vulgo.
 250 *Sherardia teucrij* folio, flore purpureo. Vaillant. Disc. p. 49.
Verbena folio subrotundo, serrato; flore cæruleo. Sloane Hist. Vol. I. p. 171. Tab. 107. fig. 1.
 191 *Sideritis arvensis*, latifolia, glabra, C. B. 233.
 192 — vulgaris, hirsuta, erecta. C. B. ib.
 393 — *Cretica*, viscosa; bitumen olens. Zanon. 186.
 287 *Sonchus lævis* in plurimas & tenuissimas lacinias divisus. C. B. 124.
 288 *Spinacia Cretica*, supina; capsulâ feminis aculeata. T. Inst. 533.
 89 *Stachys Cretica*, C. B. 236.
 90 — folijs sub verticillis latioribus, acuminatis, flore majore.
 91 *Stachys major Germanica*. C. B. 236.
 92 — folio obscure virente, flore ferrugineo. H. Ox. 3. 382.
 93 — *salviæ* folio, flore luteo. D. Jussieu.
 94 — elatior, flore flavescente punctato.
 195 *Teucrium Bœticum*, Clus. Hisp. 229.
 196 — humilior & ramosius, folio subrotundo.
 44 *Thlaspi halimi* folio, semper virens. H. L. Bat. Alysson. T. 217.
 197 — arvense, vaccariæ incano folio, majus, C. B. 206.
 198 — vaccariæ incano folio, minus, C. B. ib.
 299 *Tithymalus erectus*, acris; parietariæ folijs glabris; floribus ad caulium nodos conglomeratis. Sloane Hist. V. I. 197. Tab. 126.
 300 *Tormentilla reptans*, alata, folijs profundius ferratis D. Plot.
Raij Syn. Ed. 2. 142.
 344 *Tribulus terrestris*. J. B. 2. 352.
 345 — terrestris, hexaphyllos, Americanus.
An Tribulus terrestris major; flore maximo, odorato, Sloane Hist. Vol. I. p. 209. Tab. 132. fig. 1?
 45 *Trifolium peltatum Creticum*. C. B. Prod. 142.
 346 — angustifolium spicatum. J. B. 2. 376.
 347 — arvense, humile, spicatum sive lagopus. C. B. 328.
folijs latioribus. Lagopodium lagopus. Tab. Icon. 524.
 348 — *Lagopus dictum*, angustioribus folijs. *Lagopus* Lob.
Icon. 39.
 349 — pratense, hirsutum, majus; flore albo sulphureo.
Raij Syn. Ed. 2. 193. Trifolium

- 350 *Trifolium pratense*, folliculatum. C. B. 329.
 46 *Veronica spicata*, hirsuta, folio subrotundo serrato.
 47 ———— multicaulis Pannonica. T. Inst. 145.
 394 ———— minor, Alpina, serpylli folio. An Ponæ?
 95 *Vicia craccæ* majori Gerardi similis, per omnia minor Anglica.
 96 ———— supina, latissimo folio, non serrato. T. Inst. 397.
 97 ———— ———— Serrato. ib.
 98 *Vicia sylvestris*, incana, major, & præcox, Parisiensis, flore
 suave rubente. T. Inst. 397.
 99 ———— ———— Sylvatica maxima. Phyt. Brit. 129.
 ——— ———— Multiflora maxima. Raij. Syn. 189.
 100 ———— ———— Multiflora, Cassubica, frutescens, lentis filiqua.
 Breyn. Prod. 52.
 48 *Virga aurea* floribus fistulosis, senecionis instar, folijs angustio-
 ribus non ferratis. H. Ox. p. 3. 125.
 49 *Virga aurea* angustifolia, paniculâ speciosâ, Canadensis. H.
 Reg. Par.
 50 *Virga aurea* altissima, ferotina, paniculâ speciosâ, patulâ.
 199 *Virga aurea*, Canadensis, asterisci folio, Par. Bat. 244.
 200 ———— ————, montana, scrophulariæ folio, Icon. Robert. Pluk.
 Phyt. Tab. 235. fig. 3.
 395 *Virga aurea*, Mexicana, C. B. 517.
 Virga aurea; limonij folio; paniculâ uno versudisposita. H. Reg.
 Par.
 396 *Virga aurea*, Americana, angustifolia, media; panicula speciosa.
 397 *Virga aurea* Americana, altissima, angustifolia ferotina; radice
 repente.
 398 *Virga aurea*, humilis; folijs rigidis, latis, utrinque acuminatis.
 Virga aurea, Noveboracensis; glabra, caulibus rubentibus,
 folijs angustis glabris. Flor Boerh. Ind. alt. 97.
 399 *Virga aurea*, montana; folio angusto, subincano; flosculis con-
 globatis. Raij. Syn. Ed. 2. 81.
 400 *Virga aurea* minor; folijs ferratis, utrinque acuminatis.

XXIII. PAPERS omitted.

- n. 390. p. 353. 1. Dissertatiuncula de agno vegetabili Scythico, Borametz vulgo
 dicto; auctore D. Joh. Phil. Breynio, M. D.
 n. 421. p. 219. 2. A botanical invitation to forward an history of plants in Swif-
 ferland. By Dr. J. J. Scheuchzer to Sir H. Sloane.

XXIV. ACCOUNTS of books omitted.

- n. 398. p. 264. 1. Vegetable Staticks. By the Rev. Mr. Steph. Hales.
 n. 399 p. 323. 2. The first decad of a book, entituled, Joh. Martyn Historia
 n. 407. p. 4. plantarum rariorum.

The End of the SECOND PART.

Fig. 63.

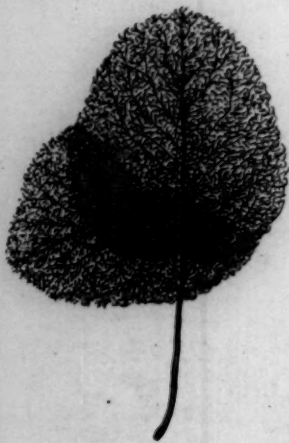


Fig. 64.

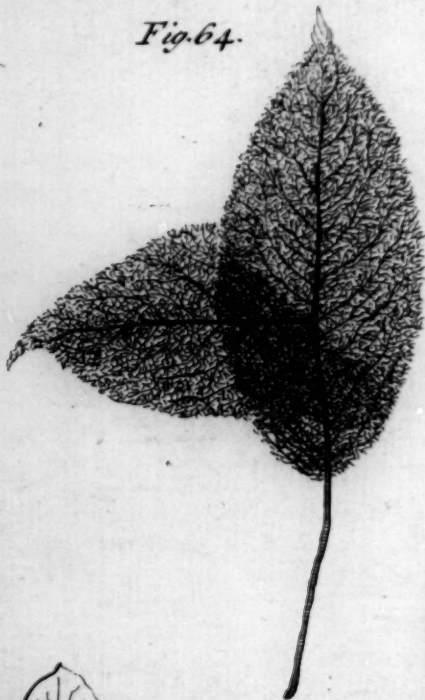


Fig. 65.

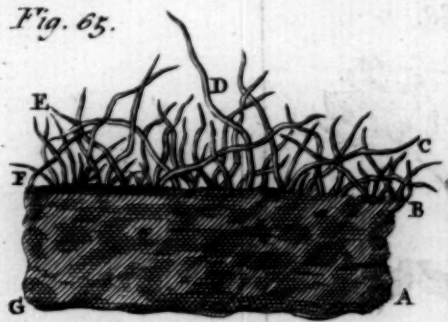


Fig. 69.

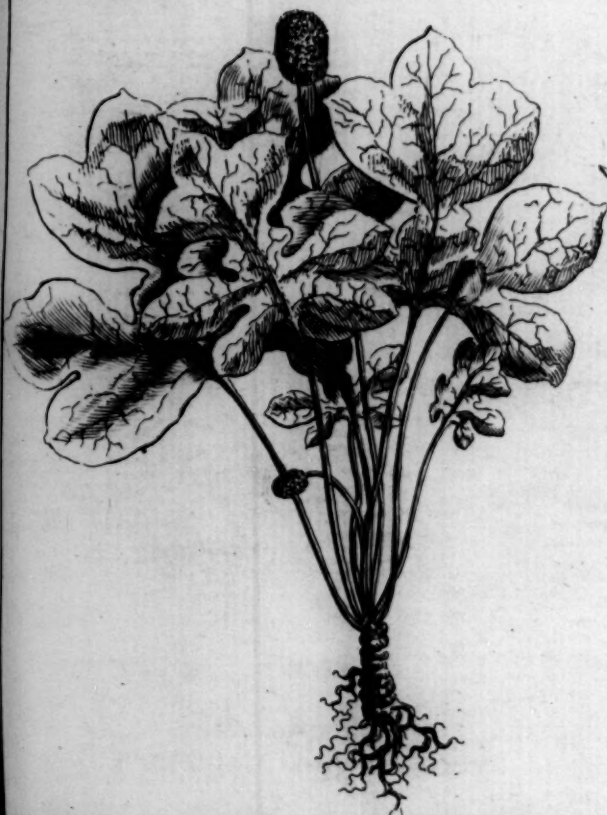
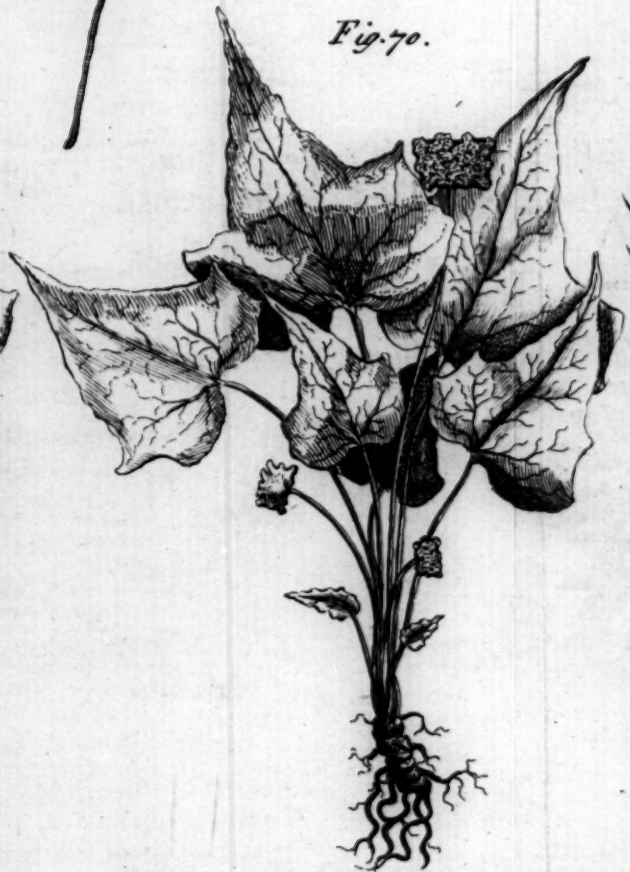


Fig. 70.



DORSTENIA *Dentariae radice Sphondylii folio* placenta ovali. . placenta quadrangulati et undulata.

Fig. 66.

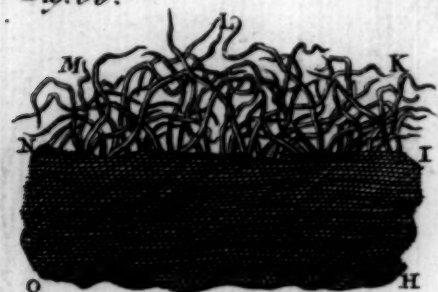


Fig. 67.



Fig. 68.



Fig. 71.



Fig. 73.



Oxyoides Malabarica Sensitive,
Caulis viridi glabro altior, flore majore.

Oxyoides Javanica Sensitive, Caulis rubescens
herule flore luteo minore

Fig. 72.



Fig. 75.



The fruit of *S. Musa*.

J. Myrde Sc.



THE
Philosophical TRANSACTIONS
ABRIDGED.

PART III.

Containing the
Anatomical and Medical PAPERS.

CHAP. I.

Zoology, Anatomy of ANIMALS.

1. 1. **Q**UAMVIS contradictiones quamplurimas passus sim & adhuc patiar, permanebo in systemate meo de animalium ex animalculis generatione, quoniam animalcula in omnigenis seminibus inveni, si saltem animalia rite tractare possem, ne exceptis quidem variis avium ac piscium speciebus. Porro comperimus in omnibus arborum & plantarum seminibus etiam si parvissimis, si modo tractari possint, plantam esse formatam, quam plantam antea comparavi cum animalculis seminis masculini. Et farinosa materia in seminibus plantarum plantis nutrimento esse debet donec planta suos ejecerit radices, & ex terra ali possit.

Quod ad illos attinet, qui novum super mea fundamenta struxere systema, affirmantes ovum esse proprium nidum in quo animalculum seminis masculini hospitatur, idemque ovum ex eo imprægnatum postea per tubam Fallopianam deduci ab ovario ad uterum; percipere non possum quomodo positiones adeo vanas statuere easque in lucem edere audeant; sunt enim adeo omni fundamento carentes ut ulteriori contradictione indignæ sint.

Of the generation of animals. By Mr. Ant. Leeuwenhoek to Dr. Jurin, Nov. 1723. 380. p. 438.

*Observations
upon a foetus
and the parts
of generation
of an ewe.
By the same.
n. 373. p.
151. Sep. &c.
1722.*

2. **A**N ewe which in two years had lambed twice, was covered by a young ram about 20 weeks old in the owner's presence: five days thereafter he killed the ewe, and observing her uterus four times bigger than ordinary, he brought it with the ovaria to me, affirming that it was not yet quite five days since the young ram had covered her, and that there was no other ram thereabouts. I first tried to penetrate into the womb from the vagina, with the point of a small pair of scissars, but I found it so close that I could not enter it, therefore I cut a piece off from the womb, out of which ran a clear water, and within it lay the foetus with all its coverings. I spread this upon the backside of a china tea dish, and finding that it still contained more water, I made a small incision to drain it and to let it dry, that I might observe it the better. I could plainly see the vertebræ of the neck and back as also the joints of its short tail; and thought I likewise saw the eyes. But when it was quite dry I could not observe its backbone so well as when moist, tho' the painter who made the draught and had better eyes than mine, saw it very distinctly. My design in drying it was to cut it in small slices that I might better observe the inner parts, for it was so extremely soft and tender when moist that with the least touch its parts would be disorder'd and confounded. Therefore I cut this foetus into fifteen slices and observed them with a microscope, but could not be very certain what I saw. I thought I saw the intestines, as also the bladder, and coming to the breast I fancied I saw the heart; but I observed with a great deal of pleasure that two blood-vessels lay near together in the brain, and how they were spread into branches. I had this foetus AB drawn as it lay in its Teguments. ACDEIK and AFGHLK are the membranes wherewith it was involved in the manner as I had spread and dried them, wherein the blood-vessels as much as possible are delineated. Some persons might expect that I should have look'd for the extremities of the blood-vessels: but the blood-vessels have no end, as I have frequently said. Besides, they become gradually so exquisitely fine that the blood which passes thro' them can exhibit no red colour to our eyes; so that there is no tracing them when entering into the vessels that return the blood back to the heart, except in living animals, where one may see the blood enter into the returning vessels. Before the man gave me this uterus he squeez'd it betwixt his fingers and told me that he could feel nothing in it; and this I believe he had done several times, by which means he tore off the vessels whereby the foetus was fasten'd to the uterus; which I suppose was the occasion that upon opening the uterus the foetus with its coverings came so easily away.

Fig. 1.

Fig. 2.

I also took a draught of the tuba Fallopiana, MNOP. At P is the imaginary orifice which is thought to suck the egg from the ovarium, according to the old absurd notion; at M is shewn where the tube increases

creases in bigness, and at QR the fleshy substance which I cut away from the uterus. I then also cut off the so call'd ovaria and the pretended ova, which latter seem'd much too big to pass upon conception thro' the tubæ Fallopianæ. I therefore measured the length and breadth of the foetus with a pair of compasses, and the middle number between these I multiplied twice by itself to bring it to a cube number. I next took the length of an axis of an ovum as it lay in the ovarium inclos'd in its membranes, and taking the cube of that length and dividing one cube number by the other, I found that such an ovum was about seven times bigger than the foetus, notwithstanding it was near five days grown. I shew'd this foetus with its covertures to two physicians and one surgeon, and gave them the pretended ovaria in their hands; who all agreed that not one ovum was missing out of the ovaria. Then I asked them how it was possible that such an ovum could pass thro' the Fallopian tube? Whereupon the one said that the ovarium was quite out of doors and that it was nothing but some fleshy substance. But the other said that notwithstanding this all animals came from an egg; and the last told me that he believed that tube to be neither of a sheep nor a lamb; but I shew'd them that it was from an ewe which at least had lamb'd twice, and yet that the tube was neither thicker nor wider than the tube of a lamb.

After having kept these ovaria some days, by which means they were pretty much shrunk in the drying, I order'd them to be drawn that the bigness of the eggs might be observ'd. ABCDE is the ovarium on that side of the uterus in which the foetus had lain. You must observe that the uterus of a sheep is divided by a membrane, so that the young ones cannot touch one another. DEA is the part where it was fastened. In this ovarium you may observe a round protuberance which is beset with several others; this great protuberance is what is called an ovum. This ovarium is not here represented so large as it was when I cut it off from the parts that it grew to. There was besides at one side of that ovarium a large round body grown to the ovarium, which seem'd also to be an ovum FG, on which there appear'd several other little round bodies protuberant from it. Now on the other side of the uterus, there was a large fleshy prominent ovum which might plainly be observed without a microscope, whose bigness is drawn at HI, upon which you may also observe a smaller round body, and out of that again other still smaller round bodies appear protuberant. After I had quite dried these eggs represented in fig. 3, 4 and 5, I still observ'd more and more of the prominent round bodies upon them, insomuch that upon one of them I told sixteen round little bodies, whereof some by losing all their moisture were sunk in and had a dent in the middle. I cut these eggs with a very fine sharp knife into thin slices, and then observing them with a microscope, I saw blood-vessels in them and also other sorts of vessels which I did not take for blood-vessels, and among the rest one so big that

Fig. 3.

Fig. 4.

Fig. 5.

that a hair of ones head might enter it, besides abundance of others exceeding small. After many observations, I could think no otherwise but that the so call'd eggs consisted of nothing but vessels, and that the superfluous moisture which was sent to these eggs did not circulate, except only what was in the blood-vessels, and so by overcharging the vessels elevated them into these small protuberances, and sometimes bursting them thereby left a dent in the middle; which having been observ'd by some persons they firmly believ'd that to be the place out of which the ovum was suck'd from whence the foetus sprung. I was very sorry that I did not get this uterus before it was squeez'd, for I do not question but that I might have discover'd all the members of this foetus, since I could plainly observe its backbones even with the naked eye, and that in a foetus not of quite five days growth. I hope after this nobody will pretend to say that the animal in utero at the beginning is nothing but an unform'd mass. These observations I made in Sep. 1718.

Of the external maxillar and other salivary glands:
By Dr. Rd. Hale, n. 364.
p. 5. Jan. 1720.

II. **T**HE external maxillar glands in brutes are of the conglomerate kind. They lie externally, laterally (lengthways) on the lower jaw, partly under the depressor labiorum, and partly under the buccinator. A strong membrane intervenes between these glands and the jaw on one side, and between them and the buccal glands on the other side. They are more or less red (like the pancreas) according to the quantity of blood that remains in them, otherwise their substance is white.

These glands receive arteries from the external carotids, veins from the external jugulars, and nerves from the third branch of the par quintum.

The number of excretory ducts from these glands is not always the same in the same species of animals. In cows generally fourteen are discovered by the probe. Their orifices are valvular, about four times less than their ducts. Every duct is about half an inch from the next. Those in the middle of the glands are largest, because the glands are there broadest and thickest. The ducts don't communicate with one another, nor with the buccal. Every duct is made of lesser ducts united, which rise from the lobules (thro' the whole substance of the glands) which constitute each distinct lobe, and has the same structure as the pancreatic duct. Each lobe is depressed on its sides, where it is joined to other lobes; and between the lobes many buccal glands are interspersed.

In calves seldom more than six or seven ducts admit any probe; when the animal grows older the ducts appear more plain and open.

In sheep six excretory ducts are always found in each external maxillar gland.

In dogs and cats, &c. these ducts are fewer in proportion to the smallness of the glands. 'Tis observable that these ducts in dogs open obliquely

obliquely towards the mouth, whereby the saliva may be better mixt with the food in mastication: which might be swallowed unmixt from another structure of ducts in animals that swallow greedily.

Dr. Wharton * first mentions the external maxillar glands. What he says of them is applicable only to their appearance in human subjects, where they are of the conglobate kind and very small, unless in scrophulous and venereal cases. 'Tis plain that he had not seen them in brutes; for in his figures (which were drawn from brutes) no notice is taken of them. He describes them as very small, and calls them emunctories of the nerves, which was the notion (in his time) concerning the use of the conglobate glands; and the saliva was said † *è nervoso genere profund.*

Steno ‡ justly blames Blasius for ascribing to the external maxillars an excretory duct opening into the mouth, like the common one from the parotid gland. Yet Steno (otherwise very accurate) does not truly describe these glands nor distinguish them from the buccal, tho' they are as distinct from them as the sublinguals are from the internal maxillars. Steno divides his buccal into 3 parts. The large ducts in a line rise from the external maxillars; and how distinct these glands are from the buccal appears plainly in fig. 9th &c. Steno's second part of the buccal (‡ *intra quæ, & in mediâ parte*) are mark'd *ee*, in fig. 6 *quæ alias, &c.* higher are the same *ee*, among the papillæ. The third part (*quæ à superiore descendunt*) are *abcd*.

The external maxillars differ from the buccal in bigness, figure, structure, particular number of ducts, colour, &c. The buccal, labial, internal maxillar and sublingual glands are of a yellow colour; besides, the buccal are separated from the external maxillars by a strong membrane. Indeed many of the excretory ducts of the buccal glands open near the ducts of the maxillars (from whence Steno confounded these glands) but they do so likewise round his own ducts from the parotids; and some ducts from like glands open near the sublinguals, as also about Nuck's ducts, in which places the buccal ducts are most numerous.

In short there is a very great number of excretory ducts dispersed all over the membrane that invests the mouth, fauces, &c. which rise from glands that lie under this internal membrane. These glands are more numerous in some parts than others, and receive different names, according to the part they belong to; as labial, buccal, palatine, &c. But these are small glandules with one excretory duct, and tho' they separate saliva like the large conglomerate glands, parotids, maxillars, &c. yet they differ from these in construction, one common excretory duct, &c. Whereas the external maxillars differ from all the other glands of the mouth, viz. by many ways from the buccal besides their colour; in which particular they are also distinguished from the inter-

nal maxillar and sublingual glands; they differ also from these as well as from the parotids, in having a great number of common excretory ducts. This number of excretory ducts was not observed by Steno; nor did he know that these ducts in the same line were the excretory ducts of large conglomerate glands (like the parotids) distinct from the buccal.

Bartholine * mentions the external maxillar glands, but does not describe them. Nuck † only gives them a place in his catalogue of glands, but takes no farther notice of them, tho' he writes a book ‡ chiefly about a new salival duct rising from a gland that is found in no animal besides a dog.

Mr. Cowper had never seen these external maxillar glands, as appears by a letter of his (now by me) written above twenty years ago, in answer to one I sent him upon the first discovery of these glands. The external maxillars in men (of the conglobate kind) are marked g, in the first figure of his *Myotomia reformatæ*.

The ducts of the external maxillar glands are opposite to the orifices of Steno's ducts; from which glands and ducts, as also from the buccal, labial, and gingival glands, the saliva flows from all parts of the mouth without the teeth. From Wharton's and the sublingual ducts, from the tonsils, fauces, fretum Stenonis, gingival, lingual and palatine glands, the saliva is derived from the upper and lower, former and hinder parts of the mouth within the teeth.

What has been said of these salivary glands, &c. will be best understood by the following figures, which were drawn for me in Oct. 1697. at Oxford, and have been lately compared with the parts themselves in cows, calves, &c.

Fig. 6.

Fig. 6.

Represents part of the left cheek of an ox, separated from the lower jaw-bone, with the external maxillar glands, its ducts, &c.

1, 2, 3, &c. to 14. Bristles inserted into the ducts of the external maxillary gland, *lll*. These ducts open sloping into the mouth, for the better mixture of the saliva with the food.

15. The duct 3 injected with wax, to discover its division and bigness in respect of the orifice.

16. A lobulus of the maxillar gland. Its excretory duct is filled with wax and ends at 15.

17. The duct 1 laid bare and open'd, to shew its large cavity, &c.

A A, Part of the muscles and fat, &c. belonging to the lower jaw.

B B, Part of the ~~internal~~ membrane that invests the mouth.

a b c d, Bristles in these ducts of the buccal glands *nn* that would admit them.

e e e, Those orifices of the buccal glandules that were too little to admit bristles.

* Page 342.

† Adenol, p. 5. n. 11.

‡ Dialog. p. 15. 158.

kkk, The

kkk, The papillæ on the inside of the mouth.

lll, The lobes that constitute the external maxillar gland.

mmm, The orifices of the labial glandules *pp*, that were too small for passing bristles.

nnn, Buccal glandules interspersed between the lobules of the maxillar gland.

nnn near *rrr*, part of the buccal glandules where they appear thickest, and are raised to discover the ducts *rrr* running under them.

ppp, The labial glandules like the buccal. Mr. Cowper in fig. 4. letters them H, H.

rrr, The ducts marked 6, to 14, as they appear under the glandules *nn*.

The same numbers and letters express the same things in the following figures.

Fig. 7.

Exhibits part of the left jaw-bone and cheek of a sheep, where the bristles 1, 2, 3, &c. shew the constant number of excretory ducts from the external maxillary gland in these animals.

Fig. 8.

Shews part of the right cheek of a large dog taken from the lower jaw-bone.

Fig. 8.

f, The orifice of Steno's salival duct.

g, The orifice of Nuck's duct, which rises as a papilla on the membrane B B.

h, Nuck's new duct, not found in men, oxen, or sheep, but in dogs, their orbit not being entirely bony.

i, Nuck's gland.

ooo, The orifices of some excretory ducts belonging to the external maxillar gland, that were too strait for the admission of bristles.

qq, The teeth. In this subject they are the teeth of the upper jaw; near the second of which the orifice of Nuck's duct appears.

Fig. 9.

Demonstrates the back part (next the cutis) of the external maxillar gland of the same dog, as 'tis beset with the buccal glandules.

Fig. 10.

Explains the external maxillar gland in the right cheek of a calf. In this subject I could only probe two ducts; 3, &c. would not admit bristles.

III. **T**HE insertions of all the lymphatic vessels into the veins can be discovered but in few subjects, and no figure has yet been given of them.

The following figures shew the course of the lymph both below and above the subclavians in men, and axillars in dogs. The lymph below the receptaculum chyli is conveyed from all the inferiour parts by a great number of small lymphatic vessels, which uniting with others obliquely above the valves become bigger in proportion, till at length

The insertions of all the lymphatic vessels into the veins. By the same, ibid.

length they constitute two large trunks near the emulgents, which are the pedunculi or beginnings of the receptaculum chyli. The lymph from the parts above the subclavians is derived in like manner from lesser lymphatics to the common ducts here delineated.

I know Pecquet has given a cut of the thoracic duct in a dog; which duct is double from the receptacle, and is inserted by four branches into each axillar. I believe with * Bartholine, (who has borrowed this figure from Pecquet) that such an insertion is a *lusus naturæ*. For tho' the thoracic duct may be double, and is sometimes divided into two parts near the subclavians, yet generally it is single, the lymph from all parts on both sides the body being carried by proper lymphæducts into one common thoracic duct that conveys this liquor together with the chyle from the lacteals into the left subclavian vein, by one, three, or more branches. For there is as great a variety in the number of these branches as in the places of their insertion.

Mr. Cowper injected the thoracic duct in a human subject, and has given a figure of that preparation in his book of anatomy. But this figure is imperfect, and the insertion of the thoracic duct so ill drawn that little can be learnt by it. However, no anatomist has given any cut that demonstrates the insertions of the lymphatics from both arms and both sides of the head, &c. above the subclavian veins, which appear so plain in these figures that no description can make them plainer.

Fig. 11.

Fig. 11.

Demonstrates the passages, or vessels, by which the chyle and lymph pass into the veins of a dog.

12, 12 Those lymphatics that bring lymph from the thighs and lower parts.

13, 13 Are lateral lymphatics arising from the groin, testicles, and neighbouring parts.

14 The receptacle of the chyle.

15 An indenture in the receptacle, thro' which passes one tendon of the diaphragm.

16 Lymphatics from a neighbouring gland.

17 Some lymphatics from the diaphragm.

18 An artery that serves the loins, and runs through a division of the receptacle.

19 The pancreas Asellii.

20 The vasa lactea 2di generis.

21 The beginning of the ductus thoracicus.

22 Some divarications of the ductus.

23 The continuation of the ductus and its progress.

24 The aorta descendens. N. B. 18. 24. by their pulsation (and the tendon at 15) much promote the ascent of the chyle and lymph.

25 A common divarication of the duct.

* Barth. p. 616, 620.

Fig. 6.

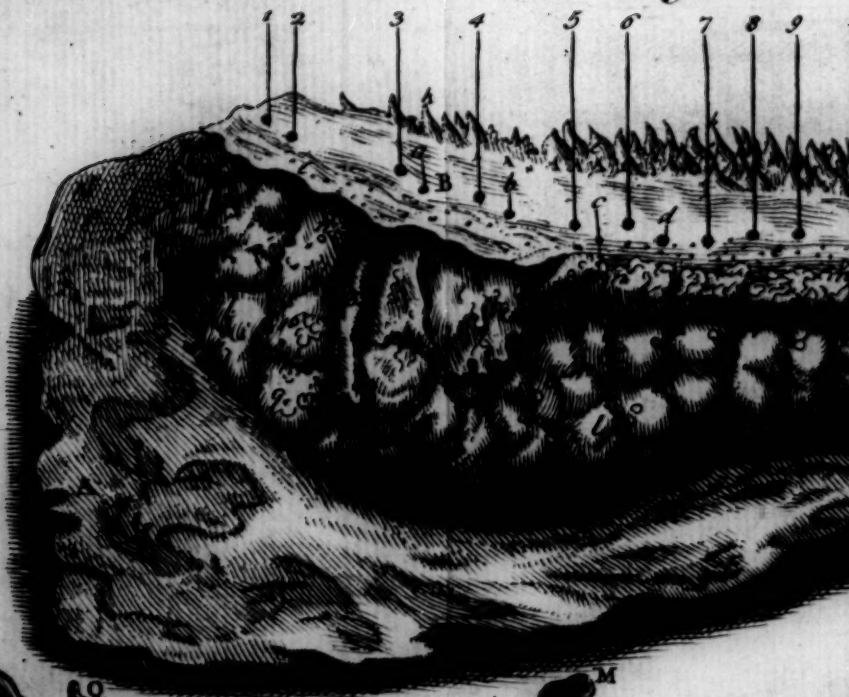


Fig. 2.



Fig. 3.



Fig. 4.



Fig. 5.



Fig. 1

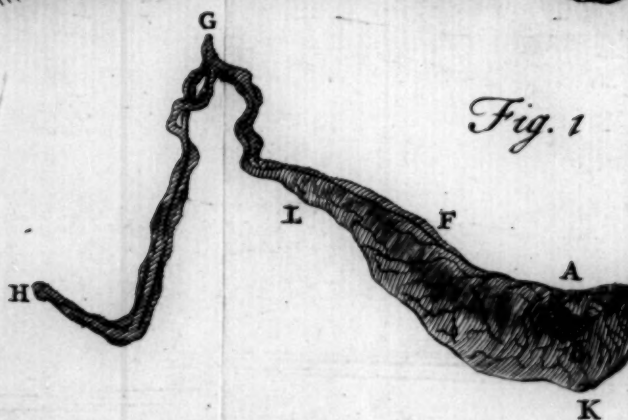


Fig. 9.

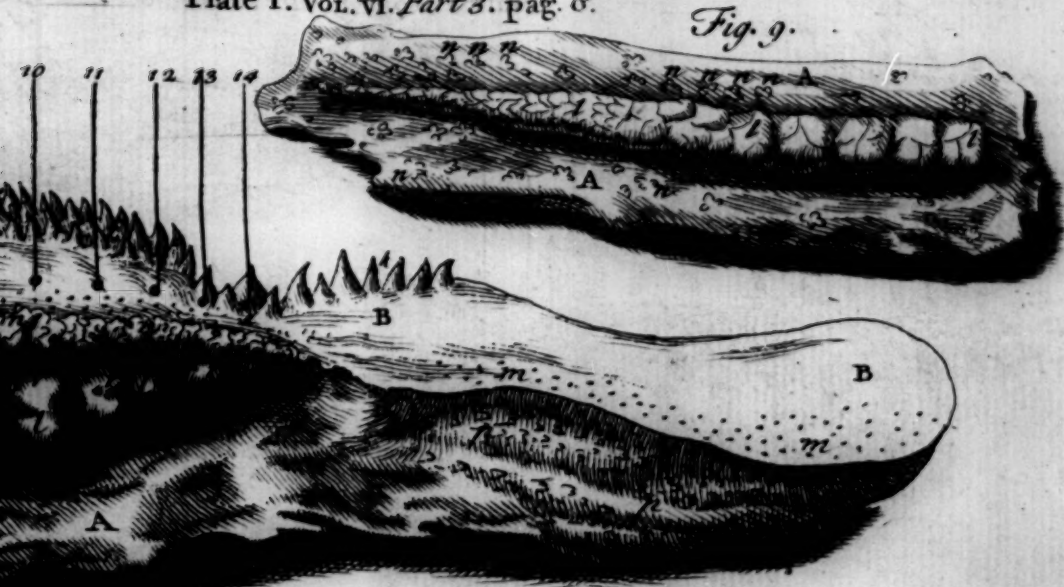


Fig. 7.

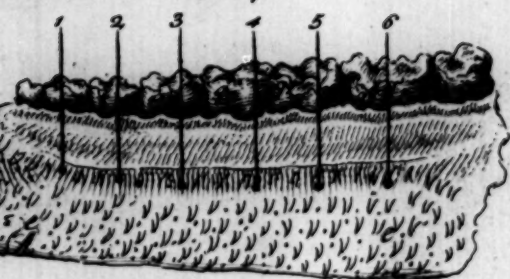


Fig. 8.



Fig. 10.

- 26 A lymphatic from some neighbouring gland.
- 27 A double lymphatic from the secondary gland 42, in fig. 12.
- 28 That part of the ductus thoracicus where both its branches, and the lymphatics from the left side of the head and left fore-leg meet.
- 29 The lymphatics from the left side of the head and left fore-leg united; they lie on the inside of the vein.
- 30 A lymphatic with a pin in it from a neighbouring gland, perhaps the thymus.
- 31 A lymphatic from the neck, &c. It is divided and enters the jugular by two distinct branches under the sacculus 43.
- 32 The lymphatic from the right side of the head.
- 33 The lymphatic from the right fore-leg.
- 34 The large sacculus, or receptacle of the lymph, on the right side, that receives all the lymph on that side and conveys it into the jugular.
- 35 The cava descendens.
- 36 The vena mammaria, which is sometimes single.
- 37 The venæ subclaviæ.
- 38 The vena vertebralis.
- 39 The axillars.
- 40 The jugulars.
- 41 The right internal jugular not injected.
- 42 A small secondary lymphatic gland on the back part of the top Vid. Fig. 12. of the thorax.
- 43 The sacculus that receives all the chyle and lymph from the whole body (except 30, 31, 32, 33, 34.) and discharges it into the vein: at least we know of no other lymphatics that any where else enter the veins.
- 44 A lymphatic (or membrane, for 'twas not injected) that joins 29 to the largest branch of the ductus thoracicus.

Fig. 12.

Is the upper part of fig. 11. revers'd, the duct, &c. being turned up, that the insertion; both sacculi, &c. may be better discovered.

This is to be explained by the preceding, and has only from 42 to 44 more figures than the upper part of fig. 11. has; all which are already taken notice of.

In this subject the chyle and lymph are emptied into the jugulars and not into the axillars; they are sometimes emptied partly into the jugular, and partly into the axillar or subclavian. In men generally into the subclavian.

IV. **T**Hough the Coati Mondí of Brasil is seldom or never brought alive into Europe, yet there were two of them found in Captain Green's ship who was some years ago tryed and condemned here for piracy; one of which dyed in my custody of a wound it had received in the thigh: I caused it to be dissected and have sent you the

Of the Coati Mondí of Brasil. By Dr. G. Mackenzie to Sir H. Sloane. n. 377. p. 317. May 1723.

Of the Coati Mondí of Brasil. PART III.

account of it, which differs from the Parisian Academists account in the following particulars; most of which may proceed from the difference of sex, theirs being a male and ours a female.

Theirs was six inches and a half from the end of the snout to the hinder part of the head, ours was only four; theirs was sixteen inches from the occiput to the beginning of the tail, ours was ten; theirs from the insertion of the tail to the end was thirteen inches, ours twelve; theirs from the top of the back to the extremity of the fore feet was ten inches, ours was seven; theirs from the top of the back to the extremity of the hinder feet was twelve inches, ours eight; the snout of theirs was very long and moveable like that of a hog, but straighter and longer in proportion, but ours was only two inches; the four paws had each five toes, the claws of which were black, long and hollow like those of the castor; the toes of the fore-paws were a little longer than those of the hind-paws; the soles without hair; the palms and soles of these fore-paws were covered with a soft and tender skin; the sole of the hinder paw was long, having a heel, at the extremity of which there were several scales a line broad, and five or six long, in all which they perfectly agreed.

The ears were round like those of rats, and covered at the top with very short hairs, and in this they likewise both agreed, as they did in the eyes, which were extremely small and beautiful, but there was some difference in the hair, for theirs was short, rough and knotty, blackish on the back and head; and the rest of the body mixt with black and red; but in ours the hair was long in proportion to the animal, especially on the tail, and the whole was beautified with white and black circles, which made it have a most lovely aspect: but from the snout down all the throat and belly to the top of the tail and the inside of the legs, was of a reddish colour. The tongue of both theirs and ours was chopt with several fissures or strokes, which made it rough to the touch. The incisores were six in each jaw: the canini were very large, especially those of the lower jaw; but they did not turn up like tusks as theirs did; their figure was not round, blunt, or white, like those of a dog, wolf, or lyon, but sharp, by the means of three angles, which at the extremity form'd a point sharp like an awl. Their colour was greyish and somewhat transparent: the gula was large, and cleft like a hog's; and the lower jaw as in a hog, very much shorter than the upper.

We shall now proceed to the internal parts. By the dissection we found in ours, as the Parisian Academists did in theirs, that under the skin, and between the muscles, there was a great deal of fat, white and hard, like tallow. Theirs being a male had a penis provided with a bone, whose length did in proportion exceedingly surpass that of the bones which are found in the penis of other animals; so we in ours being a female, observed, that it had an exceeding large matrix, and that the insertion of the urethra was upon the right side of the vagina. The epiploon in ours as in theirs are very small; it had little fat, and

was

was a complication of fibres and fillets rather than a membrane; it was not laid upon the intestines, but touched upon the ventricle. In theirs they observed a very large spleen, but in ours we could discern none. We did not observe more than they any vessels in the external membrane of the ventricle but the coronaria stomachica, which appear'd as in theirs towards the upper orifice, and soon disappear'd, shooting forth a few branches. The liver in ours like theirs was somewhat blackish, and of a substance very homogeneous, without any appearance of glands: it had seven lobes, two great ones on the left side, and five other small ones on the right side. The pancreas in ours as in theirs was fastened along the duodenum, inclining more towards the right kidney than the left; but whereas it was very small in theirs, it was very large in ours. The mesentery in ours as in theirs was filled with a very hard fat, which inclosed and almost concealed all its vessels. The intestines in theirs were seven foot long and all of one thickness, having nothing to distinguish them; but in ours they were only 42 inches and a half. Theirs had no cæcum, but we found it in ours at the upper end of the rectum. The bladder was very large; the right kidney in ours as in theirs was a great deal higher than the left, and covered with the lobes of the liver. The lungs in theirs had five lobes, two on the right side and two on the left, and the fifth in the mediastinum, which was as thin as a spider's web; but in ours there were seven lobes, three on the right and three on the left, and the seventh in the middle. The heart in ours as in theirs resembled that of a dog, having the right auricle extremely great, and as they found a great deal of slimy matter hardened in the right ventricle, so we found in ours a polypus. The musculus crotophites passing under the zygoma was in ours as in theirs fastened there, being extraordinary fleshy even to its insertion, made by a very large tendon, which was inclosed between two pieces of flesh, much thicker than those which are generally found in this place, and which are thought to be put there to defend and strengthen the tendon of the muscle of the temples.

The tendons in the articulations of the fore feet were very big and strong. In ours we observed two glands on each side of the anus, with a passage to each of them full of a greyish fetid matter. The orbita in ours like theirs was not bony throughout, but it was supplied in the upper part by a cartilaginous ligament which joined the apophysis of the os frontis to that of the first bone in the upper jaw. The bone which separates the cerebrum from the cerebellum was as in dogs. The dura mater in ours did not adhere to the cranium, as in theirs. The sinus's of the os frontis in ours as in theirs were full of matter like a friable fat. The mammillares processus in ours as in theirs were very large. In the eye both of them agreed exactly, the globe not exceeding four lines and a half in diameter, the aperture of the lids being much larger, and the pupilla being as large as the whole globe of

the eye; the crystalline contained three lines in breadth, and two and an half in thickness, and was more convex inwards than outwards; this thickness of the crystalline made the two other humours to be less in quantity. The choroides was all over of the same colour, viz. of a very brown red without any tapetum, which is hardly ever wanting in the eyes of other animals.

These are all the remarkable differences that we could discover betwixt ours and that of the Parisian Academists; only I must inform you of some things as to the manner of its living and diet which they had not the occasion to observe in theirs.

I believe they are misinform'd in saying that they carry their tails erected, at least the tail of this was always trailing on the ground; neither can I be induced to believe that they eat their tails, for there was no part of her that she could endure less to be handled than her tail, the least touching of which would make her cry or rather hiss like a snake; she could endure no manner of cold; for in the intervals betwixt the times of eating she was either beneath the bed-cloaths or on a cushion before a fire with the heat of which she seemed to be extremely well pleased.

Her ordinary meat was butter'd eggs, bread and milk, all manner of roasted flesh, but no fish: I once tried her with a new kill'd partridge which she eat of most voraciously, and for several days after she was very wild and ungovernable, which made me never afterwards try her with raw flesh. I am apt likewise to believe their ordinary dens or habitations are under ground in sandy banks like our rabbits; for when she was brought to the fields she would dig up the sands with her paws with an incredible swiftness, so that had she not been chain'd there had been no possibility of recovering her.

*The anatomy
of the Mus
Alpinus or
Marmotte. By
D. J. James
Scheuchzer.
n. 397. p. 237.
Jan. &c.
1727.*

V. **R**elictis abdominalibus musculis, aperto abdomine in conspectum venit illico omentum pingue admodum, cujus tractus pinguedinosi vasis sanguiferis epiploicis intertexti pulcherrimum formant rete; sed est hæc omenti pinguedo concreta magis & compactior ea quæ mox describenda venit, ac veluti emaciata, ut omnino judicare liceat resorptas esse per hyemem durante somno fluidiores oleosi hujus liquidi partes per venam portæ, ut inservirent tum secretioni bilis quâ vesica biliaria fuit admodum turgida, tum nutrimento ipsius corporis.

Ex utroque hypogastrii latere copiosissima conspicitur & laxioris quam illa omenti consistentiæ pinguedo, quæ inde à renibus sese protendit ad inguen, formans veluti alterum, imò duplex omentum; quæ pinguedo, uti & illa mesenterii quæ ductum intestinorum omnium comitatur, adest tum ad lubricanda viscera abdominalia, tum in succi nutritii amplum penurarium.

Ad duodeni latus pro more, imò ultra ejus curvaturam, sese protendit pancreas idque valde extenuatum, in quo macilentia statu vidimus omnes alias corporis glandulas, speciatim eas quæ musculis inter-

jacent;

jacent; in his animantibus tardissima est sanguinis circulatio, tardissimæ omnes corporis secretiones, nulla interim feri vel lymphæ, quæ tardam quidem sed tamen successivam habet secretionem, resectio, ut tandem sanguis omni penè sero orbetur; hinc non mirum, quod deficiente lymphæ fecernenda glandula pancreatis & sic quoque aliæ emacientur.

Aperto duodeno in conspectum prodit bilis spumosa quæ ipsa indicat feri defectum.

In foemella hac uteri cornua sese protendunt ad duos pollices Parisinos, tubæ pertenuēs filo vix crassiores ad $\frac{1}{2}$ pollicis, ovaria 2 lineas circiter longa, unam lata, alba, sub microscopio pellucida, cum prominentibus ovulis distinctæ diaphaneitatis.

Hepatis satis magni lobi sunt sex, & aliqui horum in duos veluti subdivisi per incisuram: lobo infimo mediante membrana connectitur cum rene dextro.

Renes pinguedine toti sunt obfiti.

Renes succenturiati ad latus venæ cavæ supra emulgentes corpuscula sunt flavicantia tres circiter lineas longa vix dimidiam lata, hepar inter & renes conspicua; sed uti aliæ glandulæ macilentæ.

Ventriculi structura est, uti in animalibus aliis prohibitis & in carnivoris, simplex membranosa licet hoc animal sit herbivorum.

Singularis structuræ est fistula intestinalis in confinio intestinorum tenuium & crassorum.

Ingressus ilei in colon in diametro habet duntaxat tres lineas; colon è regione ilei 2 lineas. Sed quod incurvatur ibidem cæcum est ex amplissimis 2 pollicum in diametro. Memorabilis est valvula coli dicta, annuli ad instar rotunda, singularis prorsus structuræ; exilis quippe admodum est.

Ingressus ilei veluti inter duas tunicas conniventes, ita ut nullus prorsus concedi possit excrementis ad intestina tenuia regressus. Et membranæ duæ, quæ mutuo occurso valvulam illam formant, rhomboidalis sunt figuræ. Adfunt præterea aliæ valvulæ conniventes annulares, & veluti in ramos protensæ tres quatuorve principales versus intestinum cæcum. Illustrat hæc observatio egregie usum intestini cæci, quod in infantibus recens natis ordinariè est capacius. Inservit nempe id diverticuli loco excrementis per novem mensium decursum in intestinis colligi, nec per ea excerni solitis. Par hic est ratio animantium quæ per hyemem integram in montium cavernis dormiunt. Nulla per illud tempus fit excrementorum egestio, & tamen non obstante hac tardissimâ circulatione atque secretionem, nullâve ciborum assumptione, collectio fit eorundem, quæ ne intestina utriusque generis infarciant nimium amandantur ad cæcum, ibique ad usque vernum tempus manent; regressus autem ex eodem ad colon impeditur imprimis per valvulas ante descriptas. Ex myographia ea imprimis contemplanda duximus, quæ actiones hujus animalis distinguunt ab aliis aliorum. Immediatè sub cute crassus est & fortis musculus platysma myoides dictus, qui colli partem

partem anteriorem & lateralem, imò & totum musculus masseterem fasciæ instar involvit. Ad ipsam usque articulationem humeri cum cubito se protendens labio tum inferiori tum superiori inseritur, & motum frequentem pedum anteriorum flexorium simul & labiorum insigniter adjuvat. Hæc quippe animalia cibos pedum anteriorum beneficio veluti manibus apprehendentia ori admovent, & terram illorum ope suffodiunt.

Glandulæ thyroideæ ad laryngis latera magnæ, haud dubiè ad irrigationem muscutorum vicinorum, quorum usus admodum est frequens, quem ipsum in finem passim aliis musculis interjacent alia corpora glandulosa passim memoranda.

Sternohyoideus & sternothyroideus in ordinario sunt situ.

Fortissimus & tendinosus valde est masseter, maximi in his animalibus usus.

Fortissimus item depressor maxillæ inferioris digastricus, qui basi ossis hyoidis & ejus cornibus forti item tendine à processu styloide ortus in maxillam inferiorem ad mentum ferè usque inseritur, cujus venter anterior imprimis est crassus & posteriori quadruplo fortior.

Loco geniohyoidei externi adest statim sub mento massa carnea musculosa crassa, triangularis inde à maxillæ inferioris concursu sive angulo, sese in quinque lineas lateraliter protendens, quæ maxillam inferiorem imprimis connectere videtur. Post hunc basi linguæ insertitur musculus latus transversis fibris carnosus à maxillæ inferioris parietibus internis ortus, qui tum in mediam linguæ basin, tum in os hyoides inseritur; qui etiam supplere videtur geniohyoideum externum. Tenuis ille est & à substrato geniohyoideo interno, sive genio-glossio vix separandus.

Styloglossus fortis quoque est musculus, carnosoque principio à processu styloide ortus in fortem desinens tendinem.

Conspicui valde sunt musculi cricothyroidei item thyrohyoidei.

Ad latera gulæ & asperæ arteriæ glandulæ sunt utrinque ad digitum ferè longitudinem protensæ, quæ non nisi elevata aspera arteria & gula in conspectum veniunt, & lubricandis his partibus inservire videntur.

Fortis est musculus rectus anticus major ejusdem planè structuræ uti in homine.

Ceratohyoideus triangularis musculus à cornibus ossis hyoidis ortus in basin ejus inseritur.

Thyroarytænoideus sub sphinctere gulæ conspicuus ad id speciatim inservit, ut clangorem his animalibus proprium efficiat constringendo fortiter arythænoideas cartilagines.

Musculi pterygoidei sunt admodum fortes.

Ad supra jam descriptum platysma myoides adnotandum porro, portionem crassam satis inferi spinæ scapulæ, sed quoque eidem musculo transversim implantari alium tenuem trapezio instratum qui proin integer ex variis partibus coadunatus musculus inservit motui labiorum,

rum, flectendo cubito, levandæ scapulæ & antrorsum ducendis brachiis, quorum opera hæc animalia terram suffodiunt aliasque res suas peragunt.

Trapezium eodem prorsus modo se habet ut in homine.

Rhomboidis loco adest musculus fortis sub trapezio in conspectum veniens, qui oritur non solum à superioribus spinis vertebrarum dorsi, & inferioribus colli, sed omnibus omnino spinosis transcessibus vertebrarum colli, & insuper ab occipite, ita ut scapulam non solum retrorsum moveat, sed etiam elevet, sicque patientiæ musculum in actione sua adjuvet.

Insertio hæc rhomboidis in occiput observatur quoque in quadrupedibus aliis, & haud dubiè eum in finem adest ut caput primum pendens tanto melius sustineatur.

Patientiæ musculus tenui principio oritur ab apophysi transversa primæ vertebræ, & in principium spinæ scapulæ inseritur.

Hujus actionem adjuvat alius eodem principio ortus, qui ad finem spinæ dictæ inseritur, qui duo proin junctim sumpti totam scapulam attollunt.

Serratum inter anticum majorem, qui eodem modo se habet uti in homine, & subscapularem adest glandulosa caro magna & lata fortibus his musculis lubricandis inserviens.

Serratus anticus major non solum dentatas habet origines à costis, sed etiam fortes & crassas propagines arcessit à processibus transversis vertebrarum colli.

Aniscliptor adest duplex, unus alteri instratus, inferior & latior atque fortior dentatis veluti processibus ab ipsis costis, imprimis inferioribus oritur, & inferiori scapulæ costæ in transitu firmiter annexus lata satis basi humero uti in homine inseritur, & præterea propaginem mittit tenuem ad ipsum olecranon, ita ut non solum humerum retro deorsum trahat, sed etiam cubiti extensioni inserviat.

Musculi humeri infraspinatus, subscapularis, & rotundus uterque eodem modo se habent uti in homine.

Deltoides duplex est. Ea pars, quæ oritur à clavicula & acromio in flexuram cubiti inseritur, adeoque non tam ad humeri, quàm ad cubiti musculos pertinet; altera verò portio, quæ ab acromio & spina scapulæ oritur, exteriorem humeri situm obtinet in medium circiter humerum inserta; hunc proin non solum sursum movet, sed & extrorsum abducit.

Coracobrachialis tenuis est musculus ejusdem situs & usus ut in homine.

Inter extensores cubiti primus est tenuis, reliquis fasciæ ad instar instratus, à costa scapulæ ortus; sequuntur duo alii fortes, quorum unus etiam à costa scapulæ oritur, alter à superiore parte humeri, qui aliquandiu progressi sese uniunt & forti tendine in olecranon inferuntur.

Sub his alius latet itidem fortis, qui à summa humeri parte ortus cum anconæo sese unit.

Hic ipse autem fortior & crassior est quam in homine, & exterius atque inferius humeri latus occupat.

Inter flexores cubiti biceps ejusdem est structuræ uti in homine.

Brachialis verò interni origo sese protendit ad capitulum usque humeri, & in suo progressu hic musculus totam humeri externam partem veluti fasciatim ambit, & eodem loco uti in homine inseritur.

Flexores carpi adfunt tres; extensores carpi tales sunt quales in homine.

Extensores digitorum sunt primò communis qui in tres digitos priores inseritur ab humero ortus. Secundus cubito descendens in ultimum & penultimum inseritur.

Adest & indicator seu extensor indicis.

Pronatores se habent uti in homine.

Ex supinatoribus longus brevior est brevi, cæterum ejusdem situs uti in homine.

Aliorum musculorum descriptiones reservamus in aliud tempus.

Figurarum explicatio.

Fig. 13. A B Gula. C D Duodenum. E Ventriculus.

Fig. 14. E H Ilei portio. G H Coli portio. H F I Cæcum.

Fig. 15. aa Coli valvula, prorsus fere uti depingitur in homine, nisi quod fermè sit rhomboidalis. bc Apertura ilei in colon.

Fig. 16. K. Portio cæci, cujus ima pars est aperta versùs colon, ut valvulæ conniventes ramosæ ooo in conspectum veniant.

A description of the Moose-deer in America by Paul Dudley, Esq; n. 368. p. 165. May & c. 1721,

VI. **T**HE Moose is a creature not only proper but it is thought peculiar to north America, and one of the noblest creatures of the forest; the Aborigines have given him the name of Moose, Moosuk in the plural.

Of moose there are two sorts, the common light grey moose by the Indians called wampoose; these are more like the ordinary deer, spring like them and herd sometimes to thirty in a company. And then there are the large or black moose, of which I shall now give you the following account.

He is the head of the deer-kind, has many things in common with other deer, in many things differs, but in all very superior. The moose is made much like a deer, parts the hoof, chews the cud, has no gall, his ears large and erect. The hair of the black moose is a dark grey, and upon the ridge of his back to ten and twelve inches long, of which the Indians make good belts. He has a very short bob for a tail.

Our hunters have found a buck or stag-moose of fourteen spans in height

height from the withers, reckoning nine inches to a span; a quarter of his venison weighed more than two hundred pounds. A few years since a gentleman surprised one of these black moose in his grounds within two miles of Boston; it proved a doe or hind of the fourth year; after she was dead they measured her upon the ground from the nose to the tail between ten and eleven feet, she wanted an inch of seven foot in height.

The horns of the moose when full grown are between four and five foot from the head to the tip, and have seven shoots or branches to each horn, and generally spread about six foot. When the horns come out of the head they are round like the horns of an ox; about a foot from the head they begin to grow a palm broad and further up still wider, of which the Indians make good ladles that will hold a pint. When a moose goes through a thicket or under the boughs of trees he lays his horns back on his neck, not only that he may make his way the easier but to cover his body from the bruise or scratch of the wood. These mighty horns are shed every year. The doe-moose has none of these horns.

A moose does not spring or rise in going as an ordinary deer, but shoves along side-ways throwing out the feet much like a horse in a racking pace. One of these large black moose in his common walk has been seen to step over a gate or fence five foot high. After you unharbour a moose he will run a course of twenty or thirty miles before he turns about or comes to a bay; when they are chased they generally take to the water; the common deer for a short space are swifter than a moose, but then a moose soon outwinds a deer.

The flesh of a moose is excellent food, and though it be not so delicate as the common venison yet it is more substantial and will bear salting: the nose is looked upon as a great dainty; I have eat several of them my self; they are perfect marrow. The Indians have told me, that they can travel three times as far after a meal of moose, as after any other flesh of the forest.

The black moose are not very gregarious being rarely found above four or five together; the young ones keep with the dam a full year.

A moose calves every year and generally brings two. The moose bring forth their young ones standing, and the young fall from the dam upon their feet. The time of their bringing forth is generally in the month of April.

The moose being very tall and having short necks do not graze on the ground as the common deer, neat cattel, &c. do, and if at any time they eat grass 'tis the top of that which grows very high or on steep rising ground. In the summer they feed upon plants, herbs, and young shrubs, that grow upon the land, but mostly and with greatest delight on water-plants, especially a sort of wild colts-foot and lilly that abound in our ponds and by the sides of the rivers, and

for which the moose will wade far and deep, and by the noise they make in the water our hunters often discover them. In the winter they live upon browse or the tops of bushes and young trees, and being very tall and strong they will bend down a tree as big as a man's leg, and where the browse fails them they will eat off the bark of some sorts of trees as high as they can reach. They generally feed in the night and lie still in the day.

The skin of the moose when well dress'd makes excellent buff; the Indians make their snow-shoes of them; their way of dressing it which is reckoned very good is thus: after they have hair'd and grain'd the hide, they make a lather of the moose's brains in warm water, and after they have soaked the hide for some time they stretch and supple it.

A stone taken out of a horse, at Boston in New England in 1724. By the same, n. 398. p. 216. Ap. &c. 1727.

VII. **T**HE owner of the horse never perceived that he ail'd any thing till within a few days before he died, and then suspected that he might be troubled with the gravel or stone, by the great pain the horse seemed to be in when he staled or dung'd; for he would groan and sweat prodigiously. Upon which he got a farrier who applied something to break the stone; but in a very short time the horse died; and the farrier being somewhat curious was resolved to open him, and in the great paunch found a stone of five pounds and an half weight almost as round as a globe; for it measured seventeen inches round one way, and seventeen inches and three quarters the other. The grit was like your New-castle grindstone; but was worn smooth in the horse's stomach, the colour somewhat like that of a nutmeg but more of the ordinary millstone. I could not persuade the owner to break it; but by the lightness of it considering its bulk I am apt to think it might be porous within. How long this stone was generating or what produced it is altogether uncertain. The owner of it was a common carter to a grist-mill; and some have thought that the horse might either in his provender out of the mill or by licking of mill-stones that sometimes stand up by the side of the mill get the first seed of this stone into his stomach. The weight of the stone at length made a fracture in the paunch which proved his death: for before the breach and while the stone roll'd in his stomach he was very well.

The largest stone found in any animal that the Phil. Trans. give an account of, weighed but four pounds four ounces.

Two observations on the stomachs of oxen. By Ch. Price Esq; n. 404. p. 532. Oct. 1728.

VIII. **I**N the stomach of the cow I find two things well worth observing: the first is, that the villi composing the villous coat (which are in man so very small as to be scarce visible when examined separately) are in this animal so very large as to allow an exact scrutiny into their structure. Each villus is formed by a duplicature of the internal lamina of the vascular coat; from which it receives three

blood-

blood-vessels, as in fig. 17. which represents one of the villi of the stomach of an ox magnified. Whether or no the two side-vessels are arteries and the middle vessel a vein; and whether those small branches arising from the side-vessels are secretory ducts carrying a fluid from those arteries into the cavity of the stomach, making a kind of rivus perpetually running through the ductus alimentalis, I must leave others to judge.

Fig. 17.

The other thing remarkable in the stomachs of these large animals is, that their internal surface is covered by a production of the cuticle which descends from the lips quite through the alimentary passage. I am induced to believe that the cuticle is continued through the intestines as well in man as in large animals; though its exceeding fineness may make it less observable.

IX. **M**Any years since Mr. Doyly, who was a great searcher after curiosities, found a pair of extraordinary large and strangely shaped horns in a cellar, or warehouse at Wapping, where they had suffered much by worms and otherwise, being eaten pretty deep on their surfaces in many places. They had lain there so long that when he bought them no body could inform him either of the country whence they came, or when they had been lodged there. They resembled in several things the horns of goats, which made many people think that they had belonged to an animal of that kind as large as the moose-deer in America is of its kind. The royal society being informed of this matter, Mr. Hunt their operator at that time made a design of them, on which Dr. Hook read a lecture at a meeting of the society at Gresham-college. This lecture and the design are I think lost; but I remember that he suspected them to be the horns of the Sukotyro, as the Chinese call it, or Sucotario, a very large and odd-shaped beast mentioned and figured by Nieuhoff in his voyages and travels to the East-Indies*, where he gives the following description of it: "It is of the bigness of a large ox with a snout like a hog, two long rough ears and a thick bushy tail. The eyes are placed upright in the head quite different from other beasts; on the side of the head next to the eyes stand two long horns or rather teeth not quite so thick as those of the elephant. It feeds upon herbage and is but seldom taken." Many people thereupon went to see them at Mr. Doyly's, who was offered a considerable sum of money for them but refused it; and after a very severe sickness, wherein I attended him very much as he thought to his advantage, he made me a present of them.

Of a pair of very large horns, and what animal they belonged to. By Sir Hans Sloane Bart. n. 397. p. 222. Jan. 1727.

They are both almost streight for a considerable length, and then turning crooked they run on tapering towards a small and pretty sharp end. They are not round but compressed and flattish, and have large

* English Ed. p. 360.

Fig. 18.

transverse fulci or furrows on their surfaces, waved or undulated on their under parts. They differ some small matter in largeness. Measuring one from the great end or basis A B, where it was fixed to the head along the outward circumference, I found the length A C D to be six foot six inches and a half, the length by the line B D was four foot five $\frac{1}{2}$ inches, the diameter of the basis A B was six $\frac{1}{4}$ inches and its circumference one foot five inches. It weighed twenty one pounds ten ounces, and contained in the hollow part exactly five quarts of water. In the other the length of the outward circumference A C D was six foot four inches, the line B D four foot seven inches, the diameter of the basis seven inches, and its circumference one foot six inches. This weighed twenty one pound thirteen ounces and a half, and contained in the hollow part four quarts and a pint, but would have held more if it had not been very much broke at the large end.

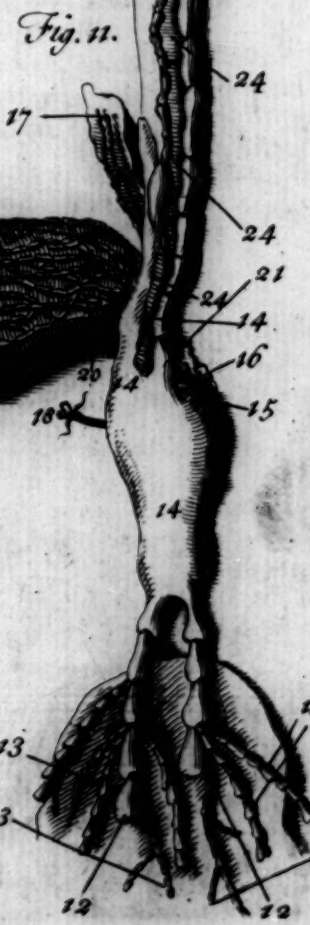
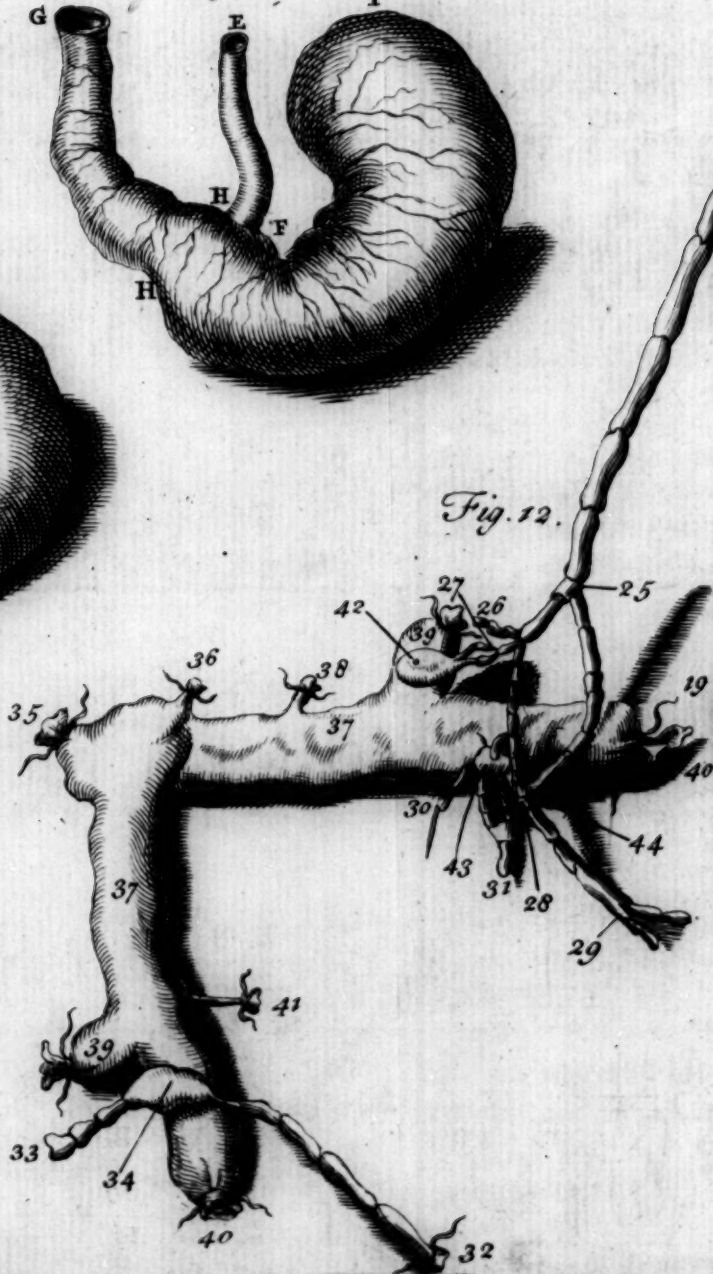
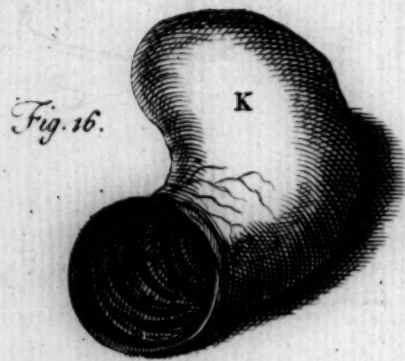
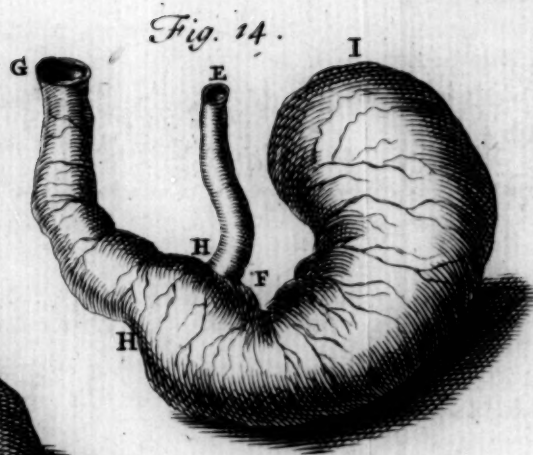
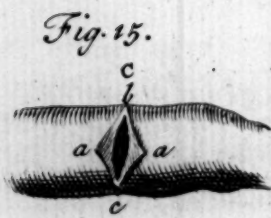
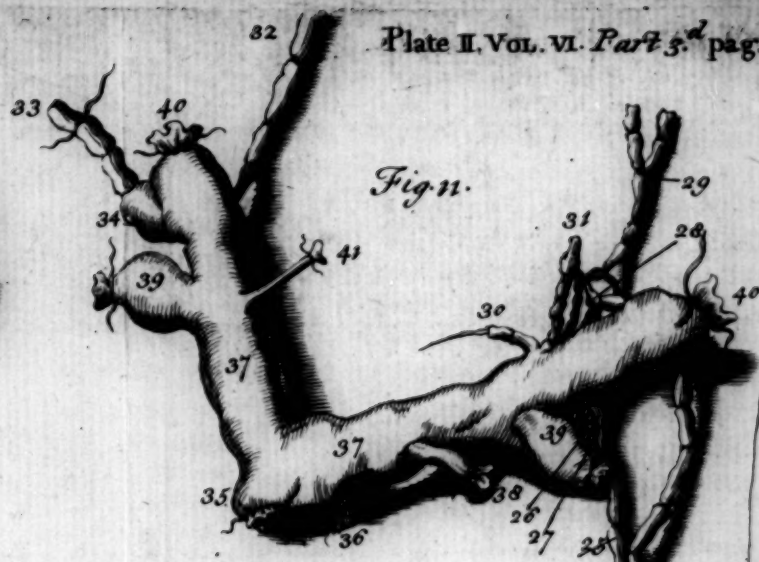
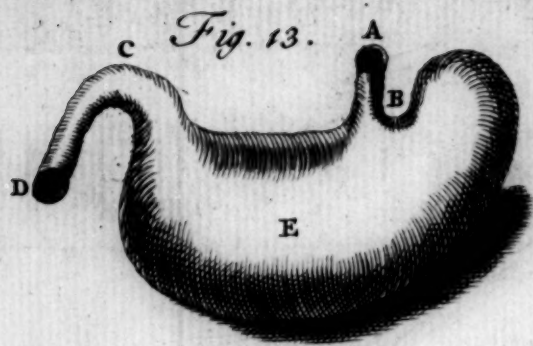
Fig. 19.

The commander of an East-India merchant ship upon seeing them told me, that he had seen such in the Indies on a large buffalo's head. I am inclined to think that they must belong to a very large sort of bulls or cows, which are natives of Æthiopia and other of the midland parts of Africa, and are mentioned by many of the antients, perhaps not without some fabulous additions, though, which is strange, very few of the modern writers take any notice of them.

Agatharchides ^b, a Cnidian who flourished about the CL. olympiad, near two hundred years before Christ, is the first among the ancients who mentions and describes this large and voracious bull; and it will appear by what follows that most of the subsequent writers have copied him. His description of this animal in some remains of his treatise of the red sea which are extant in Photius's Bibliotheca ^c, and from thence printed in the *Geographiæ veteris scriptores græci minores* published by Dr. Hudson, is, according to the translation of Laur. Rhodomannus, as follows: "De tauro carnivoro. Omnium quæ ad-

^b This Agatharchides lived in the time of Ptolomeus Philometor, and is mentioned by several of the antients as an historian and a philosopher of the sect of the Peripatetics. M. le Clere (*Hist. de la medecine*, p. 387.) ranks him among the physicians of that time, though that was not properly his profession; and the reason he gives for it is, because he described in one of his books a distemper which had not been taken notice of by Hippocrates, nor any other physician before him. We are indebted for this particular to Plutarch (*Symposiakôn lib. VIII. quæst. 9.*) who says, upon the authority of Agatharchides, "That the nations about the red sea, amongst many strange distempers they are liable to, are troubled with a particular sort of serpents (or worms) which breed in the legs and arms, where they sometimes eat their way through so as to shew their head; but upon touching are apt to slide back, and creeping between the interstices of the muscles occasion intolerable inflammations." Plutarch adds, that this distemper (which appears plainly to be the Guinea-worm, or Vena Medeni of Arabian writers, concerning which see my *Nat. hist. of Jamaica*, vol. I. p. 126. and vol. II. p. 190, 326. and which is a distemper still subsisting, as well among those very nations of which Agatharchides speaks, as among the Negroes upon the coasts of Guinea, and the inhabitants of several parts of Persia) had not been observed any where else, neither before nor since the time of this historian.

^c P. 1364. cap. XXXIX.



“ huc commemoravi immanissimum & maximè indomitum est ta-
 “ rorum genus quod carnes vorat, magnitudine crassius domesticis &
 “ pernitate antecellens, insigniter rufum. Os ei ad aures usque di-
 “ ductum. Visus glauco colore magis rutilat quam leoni. Cornua
 “ alias non secus atque aures movet, sed in pugna ut firmo tenore
 “ consistant facit. Ordo pilorum inversus contra quam aliis animan-
 “ tibus. Bestias etiam validissimas aggreditur & cæteras omnes ve-
 “ natur, maximèque greges incolarum infestos reddit maleficio. So-
 “ lum est lancea & arcu invulnerabile, quod in causa est ut nemo id
 “ subigere (quamvis multi id tentarint) valuerit. Idè rectè putatur,
 “ etiam à Troglodytis, fortitudine leonis & velocitate equi & robore
 “ tauri præditum, ferròque cedere nescium.” Diod. Siculus (Bib-
 lioth. lib. III.) hath barely and almost word for word transcribed Aga-
 tharchides, and hath added only the following particulars; that the
 eyes of this animal are shining at night; that after it hath killed other
 beasts it devours them, and that in its attacks upon flocks of cattle
 it is not to be terrified, either by the strength of the shepherds or the
 great number of dogs. The following short passage relating to this
 same animal is taken out of Strabo ^d. “ Sunt & ibidem (in Arabia)
 “ tauri feri ac qui carnem edant, nostros & magnitudine & celeritate
 “ longè exsuperantes, colore rufo.” Pliny ^e seems likewise to have
 copied Agatharchides: his words are, “ Sed atrocissimos habet
 “ (Æthiopia) tauros silvestres, majores agrestibus, velocitate ante om-
 “ nes, colore fulvos, oculis cœruleis, pilo in contrarium verso, rictu
 “ ad aures dehiscente, juxta cornua mobilia, tergori duritia silicis,
 “ omne respuens vulnus. Feras omnes venantur: ipsi non aliter
 “ quam foveis capti feritate semper intereunt.” In the xlv chap. of
 the same book he mentions a sort of Indian oxen, “ Boves Indici, qui-
 “ bus camelorum altitudo traditur, cornua in latitudinem quaternò-
 “ rum pedum.” It is not unlikely but that these Indian oxen are the
 same with the Æthiopian ones above described; especially if we sup-
 pose that the transcribers of Pliny have by mistake wrote latitudinem
 instead of altitudinem. Solinus ^f hath barely copied Pliny, with this
 difference only that he calls them Indicos tauros, whereas Pliny him-
 self hath described them amongst the Æthiopian beasts, which might
 very well happen, Æthiopia being reckoned by some of the antients
 as part of India. The description of Ælian ^g agrees perfectly with
 that of Agatharchides, of whom it seems he also borrowed it; only
 he fixes the size of these extraordinary oxen to twice the bigness of
 the common Grecian ox. There is another passage in Ælian ^h, which
 seems to relate both to this large kind of Æthiopian oxen and the
 horns now in my possession. His words are, “ Ptolomæo secundo ex

^d Geogr. lib. XVI. p. 775. edit. Casaubon.

^e Polyhist. cap. LII. p. 58. edit. Salm.

^f Hist. animal lib. III. c. 34.

^g Hist. nat. lib. VIII. C. XXI.

^h Hist. animal lib. XVII. c. 45.

Of a pair of very large Horns, PART III.

“ India cornu allatum ferunt quod tres amphoras caperet : unde con-
 “ jicere possumus bovem illum, à quo ejusmodi tantum cornu exti-
 “ tisset, maximum fuisse.” Ludolfⁱ speaking of the large Æthio-
 pian oxen, conjectures that they are the taurelephantes, which Philo-
 storgius a Cappadocian says^k were brought to Constantinople in his
 time, where he saw them. The words of Philostorgius^l are, “ Ha-
 “ bet & terra illa maximos & vastissimos elephantas ; imo & taure-
 “ lephantes, ut vocantur, quorum genus quoad cætera omnia bos
 “ maximus est, corio verò coloreque elephas, & fermè etiam mag-
 “ nitudine.

From all these several writers it appears, that there is in Æthiopia
 (and probably the midland parts of Africa where travellers seldom
 come) a very large animal of the bovinum genus, at least twice as big
 as our bulls or oxen, with horns proportionably large, but otherwise
 differing from them in many respects. It is true that in the accounts
 of uncommon things given by antient writers, an allowance must
 sometimes be made for something fabulous mixed with what is true,
 which is the less surprizing as they had many things only by hear-
 say : but as to this large sort of bulls, it is confirmed by modern
 writers that there is such an animal in those countries, though there
 is none I know of that hath given a description of it in the least sa-
 tisfactory. Ludolf^m says that there are in Æthiopia bulls of an un-
 common size, twice as large as those in Hungary and Russia ; and
 that having shewn some of the largest oxen in Germany to Gregory
 an Abissynian (from whose writings and informations he collected
 the materials for that work) he said, they were but of a middling
 size. The letters of the Jesuits frequently mention the largeness
 of these oxen, and the said Ludolfⁿ cites the following pas-
 sage out of a letter of Alphonsus Mendezius patriarch of Æthiopia,
 dated June 1, 1626. “ Buoi grandissimi, di corna sinisuratamente
 “ grosse é lunghe, talmente che nella corna di ciascuno di esse potea
 “ capire un otre piccolo di vino ; that is, very large oxen, with
 “ vastly thick and long horns, one of which would contain a large
 “ uter of wine.” F. Bernier, in his account of the Great Mogul’s
 country^o, says that among many presents which two Æthiopian am-
 bassadors should have presented to Aurengzeb there was a prodigious
 large horn of a bull full of civet, which having been measured by
 him he found the basis or large end to be half a foot in diameter.
 This horn, as Bernier farther observes, was brought by the ambassa-
 dors to Dehli the place of residence of the Great Mogul ; but it was
 not presented to him, because being distress’d for money they had
 sold the civet out of it long before they came thither.

ⁱ Hist. Æthiop. lib. I. c. 10.

^k Lib. III. c. 11.

^l Ludolf. Comment. ad hist. Æthiop. p. 145.

^m Hist. Æthiop. lib. I. c. 10.

ⁿ Comment. in hist. Æthiop. p. 145.

^o Tome II. p. 43.

Upon the whole it seems to me that these horns and likewise that mentioned by Bernier are the horns of a large sort of bulls or cows in Æthiopia and the inward parts of Africa, which in all likelihood is the same with that described by Agatharcides, Pliny, and those other ancient writers mentioned above. But I cannot as yet, for want of a more accurate description, be certain whether it is the same with the Sukotorio, or Sukotyro of Nieuhof, though there is a good deal of reason to think that it is. Gefner speaks of a very large horn which was hung by a chain to a pillar in the minster or cathedral of Strassburgh, and which is not unlikely to be of the same sort with these. He says, that being measured along the outward circumference it was found to be four Roman yards long, and he conjectures it to have been the horn of a large old Urus, which was hung up there for its monstrous size, perhaps two or three hundred years before his time. As to these, 'tis very likely that when the English had a great commerce at Ormus they were brought thither from some neighbouring country, and afterwards carried over into England by some curious person.

X. 1. **I**T is observable that among the vast variety of extraneous substances found in several layers of the earth at considerable depths, where it is impossible they should have been bred, there are not so many productions of the earth as of the sea. Again, among those which must have originally belonged to the earth there are many more remains of vegetables than of land animals. It appears however by the accounts of many both antient and modern authors, that bones, teeth, nay sometimes almost entire skeletons of men and animals have been dug up in all ages of which we have histories, and almost in all parts of the world, whereof those which were the most remarkable for their unusual size have been also the most taken notice of. Thus, for instance, they have found in Ireland the horns, bones, and almost entire skeletons of a very large sort of deer, which is commonly believed to have been the moose-deer, an animal of an uncommon size, some of which kind are thought to be still alive in the remote and unfrequented parts of the continent of America. I shall in this paper confine my self chiefly to the elephant, and such bones, dentes exerti, tusks and teeth of this animal, as are either in my own possession, or have been mentioned by authors I have met with to have been found under ground. And first, of the fossile teeth in my own collection which unquestionably once belonged to elephants I shall here produce the following.

*Of the teeth
and bones of
elephants. By
the same,
n. 403. p. 457.
July 1728.*

Nº 116 of my catalogue of quadrupeds and their parts is the dens exertus of an elephant, which was found twelve foot deep among sand or loom, as they were digging for gravel by the end of Gray's-Inn-lane near London, and preserved by tying it about with whale bones.

and tape to keep it from falling to pieces, by Mr. Conyers an ingenious apothecary, and a great collector of curiosities of all kinds.

As the greatest part of this tooth was fallen to pieces nothing could be determined about its length when entire. The largest piece, and also the most entire, hath five inches and $\frac{1}{10}$ in length, and nine inches and $\frac{1}{10}$ in circumference, consequently something more than three inches in diameter. This piece belonged to the basis or bottom of the tooth: I mean that part by which it is articulated with the head, as appears by a cavity in form of a cone, which all these tusks have at bottom, and which was filled in this with the sand of the gravel-pit wherein it was found.

The condition this tooth was found in suggests the two following remarks. It shews in the first place, how far the subterraneous steams are apt to calcine substances of this kind, which was done in this tooth to such a degree that it was grown extream brittle and ready to fall to pieces, and had moreover acquired an astringent quality common to calcined substances of this kind, which makes them stick pretty close when held to the tongue. They had altogether the same effect on the very large skeleton found near Drapani in Sicily and mentioned by Boccatus; on that remarkable one found near Tonna and described by Tentzelius†; as also on two teeth found in Northamptonshire, which I shall next take into consideration. However it doth by no means follow from thence that all teeth and substances of this kind undergo the like calcination by lying long under ground, forasmuch as there are others (as those found in Island and sent to Tho. Bartholin) turned to a perfect hard flinty substance. It serves, in the second place, to ascertain the structure of these teeth, and consequently of ivory in general, to be layer upon layer, or coat upon coat, like the skins in an onion, or rather the annual circles or rings in trunks of trees. That this tooth is composed of different coats, furrounding and placed upon each other, is very apparent by the largest piece remaining. I have already observed that this piece belonged to the basis of the tooth, and there appear in it very visible marks of nine coats, some whereof have about one tenth of an inch in thickness. Towards the further end of the tooth where it tapers almost into a point, these several coats also join together into two or three, and those pretty considerably thick. With some care these coats might be farther subdivided into a considerable number of other smaller ones, perhaps no thicker than a common parchment. Farther, the very manner of its falling to pieces is an evident proof of its structure, all the fragments being concave within and convex without, and the lines of convexity and concavity fragments of concentric circles which the several coats composed, when entire. Tho. Bartholin^a takes notice, that part of a fossil Unicorn's-horn having been

† Vol. II.
P. II. C. III.
§. xxxvii.

Fig. 20.

Fig. 21.

^a De Unicornu observationes novæ, p. 102

calcined by order of Christian IV. king of Denmark, it was found to be composed, after the same manner, of thin layers upon layers; whence he infers that it was not the horn of an animal, as was commonly pretended, but a tooth, and namely the tooth of a sort of whale in the northern seas, called Narvhal, as he had afterwards an excellent opportunity to verify by one of these unicorn's horns still sticking in the skull of the creature, which was sent to Wormius by Thorlacus Scutonium bishop of Island. Nor is this structure by any means to be looked upon as an effect of the calcination, whether brought about by the subterranean steams or by a chymical trial, but is natural to the tooth, as appears in some measure by a piece of ivory marked 1181; but still more plain in another marked 731, where several of these coats are by some disease in the tooth actually separated from each other, like the leaves of a parchment book, the ivory on the other side being still firm and close. This structure appears likewise from the teeth of the very young elephant which died at London, where the uppermost coat being very moist cracked upon drying and broke at the top.

Fig. 22.

Fig. 23.

Fig. 24.

N^o 750, is part of another dens exertus which I had from the rev. Mr. Morton, who in his Natural history of Northamptonshire gives the following account of it: "An extraordinary elephant's tooth, one of those which grow out of the upper jaw and which for their magnitude and length have by some writers been accounted horns, was lately taken out of the earth by digging in Bowdon-parva field. Even the native colour of it hath been in great measure preserved; but it is become brittle with lying in the earth; and was broken into three or four pieces transversely by the diggers in taking it up. The two larger pieces of it, which happily came into Mr. Haldford's hands, were presented to me. One of them is somewhat above a yard; the other is two foot in length; but the whole tooth must needs have been at least six foot long;—the thickest part of the biggest piece in my possession is sixteen inches round. The tooth lay buried above five foot deep in the earth. The strata from the surface downwards to the place where the tooth was lodged were as follows: 1. The soil thirteen or fourteen inches. 2. Loam, a foot and a half. 3. Large pebbles, with a small mixture of earth amongst them, two foot and a half. 4. Blue clay. In the upper part of this stratum the tooth was found." That part of this tooth which is now in my hands bears again very visible marks both of the calcination it underwent by lying in the earth, and of its laminated structure.

Fig. 25.

N^o 1185 is the dens exertus or tusk of an elephant, remarkable for its large size and for its being so very entire. It was found underground in Siberia, and was brought from thence and given to me

Fig. 26.

by Mr. Bell an ingenious surgeon, who was presented with it by the governor's lady in lieu of a reward for having cured her of a distemper, upon his travelling through the country in his passage with the caravan sent to China. It is very entire, of a brownish colour, and hollow at bottom like other elephants teeth, one of which it plainly appears to be. From the basis, measuring along the outward circumference to the small end, it is five foot seven inches long, and along the inward circumference four foot ten inches. Measuring from the inside of the basis to the small end in a streight line, the distance is three foot ten inches and a half. At the basis, where thickest, it measures one foot six inches round, and is there six inches in diameter. It weighs forty two pound. The like tusks and other bones of the same animal are found in sundry parts of Siberia to a considerable quantity; and the tusks and teeth in particular, when less corrupted, are used all over Russia for ivory. Hen. Wil. Ludolfus, in the appendix to his Russian Grammar¹, mentions them among the minerals of Russia, by the name of Mammotovoikost, and takes notice that the Russians believe them to be the teeth and bones of an animal living under ground, larger than any of those above ground. They use it in physick in lieu and for the same purpose with the unicorn's horn; and Ludolfus himself having been presented with a piece by one of his friends, who said he had it from a Russian of great quality lately returned from Siberia, found it to be true ivory. He adds that the most sensible among the Russians affirm them to be elephants teeth brought thither at the time of the deluge. The description of these teeth and bones given by E. Ysbrants Ides² is still more extensive, and withal so particular that his whole passage deserves to be transcribed at length. "Amongst the hills, says he, which are situated to the N. E. of Makoskoi, not far from thence, the Mammut's tongues and legs are found; as they are also particularly on the shores of the rivers Jenize, Trugan, Mongamsea, Lena, and near Jagutskoi, to as far as the frozen sea. In the spring, when the ice of this river breaks, it is driven in such vast quantities and with such force by the high swollen waters, that it frequently carries very high banks before it and breaks off the tops of hills, which falling down discover these animals whole or their teeth only almost frozen to the earth which thaw by degrees. I had a person with me to China who annually went out in search of these bones: he told me as a certain truth that he and his companions found a head of one of these animals, which was discovered by the fall of such a frozen piece of earth. As soon as he opened it he found the greatest part of the flesh rotten, but it was not without difficulty that they broke out his teeth, which were placed before his mouth as those of the elephant are; they also took some bones

¹ Page 92.² In his travels from Mosco to China.

“ out of his head, and afterwards came to his fore foot, which they
“ cut off and carried part of it to the city of Trugan, the circum-
“ ference of it being as large as that of the waste of an ordinary
“ man. The bones of the head appeared somewhat red, as though
“ they were tinged with blood. Concerning this animal there are
“ very different reports. The heathens of Jakuti, Tungusi, and Osti-
“ acki, say, that they continually, or at least by reason of the very hard
“ frosts mostly live under ground, where they go backwards and for-
“ wards; to confirm which they tell us that they have often seen the
“ earth heaved up when one of these beasts was on the march, and
“ after he was past sink in and thereby make a deep pit. They fur-
“ ther believe that if this animal comes so near the surface of the fro-
“ zen earth as to smell or discern the air he immediately dies; which
“ they say is the reason that several of them are found dead on the
“ high banks of the river, where they unawares come out of the
“ ground. This is the opinion of the infidels concerning these beasts,
“ which are never seen. But the old Siberian Russians affirm that the
“ Mammuth is very like the elephant, with this only difference that
“ the teeth of the former are firmer and not so straight as those of the
“ latter. They also are of opinion that there were elephants in this
“ country before the deluge, when this climate was warmer, and
“ that their drowned bodies floating on the surface of the water of
“ that flood were at last washed and forced into subterranean cavities:
“ but that after this Noachian deluge the air, which was before warm,
“ was changed to cold, and that these bones have lain frozen in the
“ earth ever since, and so are preserved from putrefaction till they
“ thaw and come to light, which is no very unreasonable conjecture;
“ though it is not absolutely necessary that this climate should have
“ been warmer before the flood, since the carcases of drowned ele-
“ phants were very likely to float from other places several hundred
“ miles distant to this country, in the great deluge which covered the
“ surface of the whole earth. Some of these teeth, which doubtless
“ have lain the whole summer on the shore, are entirely black and
“ broken and can never be restored to their former condition, but
“ those which are found in good case are as good as ivory, and are
“ accordingly transported to all parts of Muscovy. The above-
“ mentioned person also told me that he once found two teeth in one
“ head that weighed above twelve Russian pounds, which amounts to
“ four hundred German pounds; so that these animals must be of
“ necessity very large, though a great many lesser teeth are found.
“ By all that I could gather from the heathens, there is no person
“ ever saw one of these beasts alive or can give any account of its
“ shape.” What he observes of those teeth that are black and bro-
“ ken may serve as a comment to the following passage of Pliny “:

“Theophrastus autor est & ebur fossile candido & nigro colore innititur, & ossa è terra nasci, inveniri que lapides osscos.” Lawr. Lang in the journal of his travels to China, whither he went with dispatches from his Czarish Majesty in 1715, takes notice of these bones^x, as being found about the river Jenisei and towards Mangasea, along the banks, and in the hollows occasioned by the fall of the earth. He calls them Maman-bones, and informs us that some of the inhabitants are of opinion that they are no real bones, teeth, &c. but a sort of cornu fossile that grows in the earth, and that others will have them to be the bones of the Behemoth mentioned in the 40th chap. of Job, the description whereof they pretend fits the nature of the beast whose bones and teeth they are imagined to be, those supposed words, in particular, that he “is caught with his own eyes,” agreeing with the Siberian tradition that the Maman beast dies upon coming to light. The same author affirms, from the report, as he says, of credible people, that there have been sometimes found horns, jaw-bones and ribs, with fresh flesh and blood sticking to them. The same is confirmed by J. Bern. Muller in his account of the Ostiacks^y, who adds that the horns in particular have been found sometimes “all bloody at the broken end, which is generally hollow and filled with “a matter like concremented blood;” that they find, together with these teeth, or horns as he calls them, the skull and jaw-bones with the grinders still sticking in them, all of a monstrous size; and that he himself with some of his friends hath seen a grinder weighing four and twenty pounds and better; that the inhabitants make divers sort of works of these teeth, and that they are mostly to be met with in the coldest places of Siberia, as Jakutsky, Beresowa, Mangasea and Ohder. He likewise gives the description of one of these animals from the accounts of several persons, who assured him that they had seen them in the caverns of the high mountains beyond Beresowa: but as this description hath very much the face of a fable I forbear inserting it here. The author of the present state of Russia^z observes, that some of the Swedish prisoners banished into Siberia got their livelihood by turning snuff-boxes out of these teeth; and in another place^a he mentions them among the Siberian commodities, of which the Czar hath the monopoly.

The accounts which I have hitherto given of these Maman-bones and teeth, or at least their most essential parts, are confirmed by a letter of Basil. Tatischow director general of the mines in Siberia and counsellor of the Czar’s metallic council, written to the learned Eric. Benzelius now bishop of Gothenburg, and printed in the *Act. Liter. Suec.* (M. DCC. XXV. Trim. Secundum, pag. 36.) wherein he mentions the following pieces he had in his own possession. A large horn,

^x Present state of Russia, vol. II. p. 14.

^y Ibid. p. 52.

^z Vol. I. p. 12.

^a Page 78.

as he calls it, or tooth, weighing 183 pounds, which he had the honour to present to his Czarish majesty, and now kept in the Czar's collection of curiosities at Petersburg; another large horn which he presented to the imperial academy at Petersburg; another still larger than either of these two which he caused to be cut, and carved himself several things of it, the ivory being very good; part of the skull corrupted by having lain in the ground, and so large that it seemed to him to be of the same size with the skull of a great elephant; the forehead in particular was very thick, and had an excrescence on each side where the horns usually stick to it, which excrescence however, as the author observes was so small as to make him doubtful whether or no there was ever any horns stuck to them. The cavity wherein the brain was lodged was exceedingly small in proportion to the bulk of the skull. He had found also a spongy bone of a foot and a half in length and three inches in breadth sticking to the skull and of a conical figure; whence he conjectured that it served to support one of the horns, which is observed also in other animals that bear horns: lastly a grinder, which had ten inches in length and six inches in breadth, besides several of the ribs, shank-bones and other bones found from time to time, which the author forbore mentioning. The same author hath taken no small pains to inquire into the true state of those pits and hollows which the pagan inhabitants of Siberia say these animals make when they walk under ground, and found that they were nothing but caverns, such as are common in other mountainous countries, and are owing to the force of subterranean rivers and cataracts, which at last eat through and undermine the places where they pass, so as to make the ground above them give way and sink in. This is what I found remarkable in the abovementioned letter. I cannot forbear adding that although the author hath left the grand question about the origin of these bones undetermined, yet his observations seem to me to contribute very much to establish the opinion above related, that these bones are the bones, and the horns, as he calls them, the tusks of elephants drowned in the universal deluge. It is to be hoped that this matter will one time or other be set in a still clearer light, particularly after the order his late Czarish majesty was pleased to give to the governor general of Siberia, to spare no care nor cost to find a whole skeleton of this animal and to send it to Tatishchow.

Before I proceed farther I will beg leave to add one observation of Corn. le Brun, who in his travels through Russia to the East Indies tells us, that in the neighbourhood of Veronitz they had found several elephants teeth on the surface of the ground, which no body could tell how they came thither; and that the Czar's opinion about them was that Alexander the great, when he passed the Tanais or Don, advanced as far as Kostinka a small town eight wersts from thence, and that probably some of his elephants died there of which those teeth were the remains.

N^o 764 of my collection is one of the grinders of an elephant which was likewise found in Northamptonshire, for the description whereof I shall again borrow the rev. Mr. Morton's own words.
 “Northwards, says he, about fifty yards from this place, (where
 “the abovementioned dens exertus was found) was also digged up
 “one of the molares or grinder-teeth of an elephant, perhaps of the
 “same that the tusk belonged to. The grinder whole, or however
 “all the pieces of it I could find (for it was broken into three or four
 “in taking it up) being put together as they grew, exhibit thirteen
 “or fourteen parallel lamellæ; each of which extends the whole
 “length and almost the whole thickness of the tooth; and of these
 “for the main it is composed. But in a live or perfect tooth these
 “lamellæ do not appear so plainly, being in part crusted over with
 “a white osseous crust or integument, which in this fossil tooth is
 “almost wholly perished and gone, insomuch that the lamellæ are
 “more exposed to view. From the root to the top in the longest
 “part, which is near the middle of it, it is just seven inches long.
 “Its thickness in the thickest part of the root, which is also near
 “the middle of it, is almost three inches, and it is a little above
 “eight inches broad. Measuring it this way, we take in the whole
 “pile of the lamellæ. None of the lamellæ are contiguous; there
 “interposes betwixt them a thinner plate of a whiter colour and a
 “laxer texture. Three or four of the outmost at one end of the
 “pile appear undulated at the top of the tooth, are near as broad
 “at top as at the root, and have a blunt ending. The rest of them
 “are by degrees contracted to a point, are gradually shorter and
 “shorter to the other extremity of the pile, and also bend a little
 “over one another. And each of them as it approaches the top
 “divides, as it were, into several smaller teeth; and with these the
 “lamellæ of this figure terminate. The above described tooth was
 “lodged at almost twelve foot depth in the earth. Above it were
 “the following strata. 1. The top earth, a blackish, clayey soil,
 “about sixteen inches. 2. Sandy clay intermixed with pebbles, five
 “foot. 3. A blackish sand with small white stones in it, one foot.
 “4. A loamy, softer sort of gravel, one foot. 5. A sharper gravel,
 “about two foot. The tooth was found a foot and a half deep in
 “this stratum of gravel. Below this fifth stratum there was a blue
 “clay.” It is very visible that this grinder also by lying in the
 earth hath undergone the same alteration with the tusk above de-
 scribed found in Bowdon-parva field.

N^o 119 and 120 of my catalogue are two pieces of another large grinder, very probably of an elephant too, turned to a very hard, stony, and almost metallic substance.

† Nat. hist. of Northamptonshire, c. iii. §. cxxv. p. 252.

N^o 121 is a piece of the molaris or grinder of an elephant, where the undulated lamellæ are set very close to each other.

N^o 122 is a piece of another grinder perhaps of an elephant. It hath very apparent marks of being fossil as well as the preceding, and is farther remarkable for that a petrifying substance being got between the lamellæ hath very considerably separated and divided them from each other, in such a manner that they appear to have been set very loose.

N^o 427 of my collection of Quadrupeds and their parts, is part of an elephant's skull which was found at Gloucester after the year 1630, together with some large teeth, some five, others seven inches in compass, according to a short inscription written upon this very piece.

X.2. **I** Proceed now to offer some remarks on divers accounts of bones and teeth found under ground, which I met with in several antient and modern authors, and which will give me an opportunity of examining into the skeletons and parts of skeletons, which are shewn up and down as undeniable monuments of the existence of giants.

Continued. By the same. n. 404. p. 497. Oa. 1728.

And first, as many of those bones and teeth which are kept and shewn about for bones and teeth of giants have been found, upon a more accurate inspection, to be only the bones and teeth of elephants or whales, it may from thence very probably be inferr'd that others also, which for want of a sufficient description cannot be accurately enough accounted for, must have belonged either to these or else some other large animal. Thus the fore-fin of a whale stripped of its web and skin was not long ago publickly shewn for the bones of a giant's hand; and I have in my own possession (N^o 1027) the vertebra of the loin of a large whale which was brought me from Oxfordshire, where I was assured it was found under ground, and afterwards made use of for a stool to sit on. Now if a computation had been made from the proportion of this vertebra to that of the other parts of the skeleton, and all had been supposed to have belonged to a man, such a skeleton would have exceeded in measure all those fabulous skeletons of giants mentioned by authors.

I cannot forbear on this occasion to observe that it would be an object well worthy the inquiries of ingenious anatomists to make a sort of comparative anatomy of bones; I mean to examine with more accuracy than hath been hitherto done, what proportions the skeletons and parts of skeletons of men and animals bear to each other, with regard either to the size, or figure, or structure, or any other quality. This would doubtless lead us into many discoveries, and is otherwise one of those things which seem wanting to make anatomy a science still more perfect and compleat. The very vertebra I speak of may serve to shew the usefulness of such observations. It differs in many things from the vertebræ of men and land animals, as

do.

do the vertebræ of whales and the fishes of the cetaceous kind in general; and it is a very easy matter to distinguish them from each other. The body of the vertebra is considerably larger in proportion, and also lighter and more porous. The transverse processes arise from the middle of it on each side. The oblique descending processes are altogether wanting; and the arch or foramen which the spinal marrow passes through is made up by the spinal process and the oblique ascending ones only. The body of the vertebra is very rough and uneven on each end, full of small holes and eminences which receive the holes and eminences of a round bone or plate which answers to the epiphysis in a human vertebra, whereof there are two between each vertebra joined together by an intermediate strong and pretty thick cartilage, probably to facilitate the motion and particularly the flexion of these animals in the sea.

Fig. 28, 29.

There are many skeletons that were from time to time found under ground, and are mentioned by the authors who speak of them as skeletons of giants and undeniable monuments of their existence, which, as I have already observed, I should rather take to be the skeletons of elephants, whales, or some other huge land or sea animal. Of this kind seem to be the pretended skeletons of giants of twelve, twenty, and thirty cubits in height mentioned by Philostratus^c. The skeleton of six and forty cubits in height, which according to *Pliny*^d was found in the cavity of a mountain in Creta upon the overthrowing of that mountain by an earthquake. The skeleton sixty cubits high, which Strabo^e says was found near Tingis (now Tangier) in Mauritania, and was supposed to have been the skeleton of Antæus. The skeleton of Pallas, as pretended, found at Rome in the year 1500, which was higher than the walls of that city: and likewise that which Simon Majolus says was found in England in the year 1171. “Longè antè Fulgosi sæculum (are his words^f) annis
“plus trecentis, anno scilicet 1171. in Anglia, illuvione fluminis re-
“tecta sunt humati olim hominis ossa adhuc ordine composita: lon-
“gitudine totius corporis inventa est longa ad pedes quinquaginta.

There are others the description whereof concludes more clearly for their having once belonged to elephants, though it could not be positively asserted that they did. S. Austin^g discoursing of the existence and great feats of the giants before the deluge mentions in proof of what he advances, that he himself with several others saw at Utica upon the sea-shore the grinder of a man, so large, that if it had been cut into teeth of an ordinary size at least an hundred might have been made of it. Hieron. Magius^h, although himself very much

^a In Heroieia.

^d Hist. nat. lib. vii. c. xvi.

^e Lib. xvii.

^f Dierum canicularium colloq. 11. p. 36.

^g De civit. dei. lib. xv. c. ix. citatus per Cassianum & Lambecium.

^h Miscellaneorum lib. i. c. ii. p. 17.

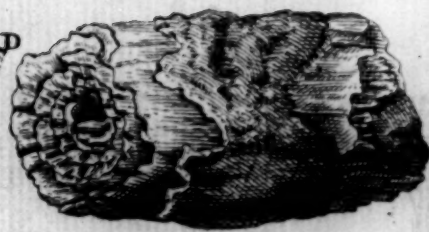


Fig. 20.



Fig. 21.

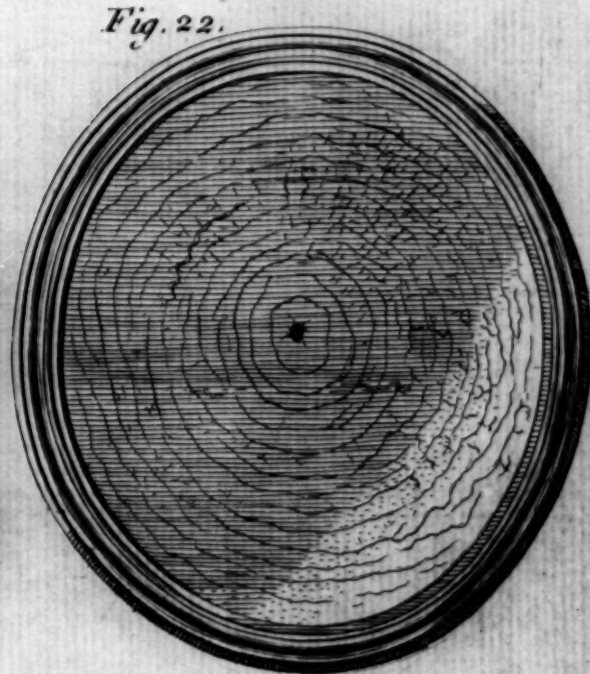


Fig. 22.

Fig. 25.



Fig. 24.



Fig. 26.



Fig. 27.



Fig. 28.



Fig. 29.



Fig. 23.



prejudiced in favour of the existence of giants, yet suspects this tooth mentioned by S. Austin to have been rather the tooth of an elephant, or else some huge creature of the sea, than that of a man. But Lud. Vives in his commentaries upon that passage of S. Austin takes notice, that in the church of S. Christopher at Hispella he was shewn a tooth bigger than his fist, which they pretended was one of the teeth of that huge saint, upon as good ground, no doubt, as that very large shoulder-bone, which Hieron. Magius says ⁱ was shewn in a church at Venice, passed for the shoulder bone of S. Christopher.

The pretended skeleton of a giant found near Drapani a castle in Sicily upon digging the foundation of a house and described by Joh. Boccatus ^k, is again not unlikely to have been the skeleton of a large elephant. For although the greatest part of the bones, thro' the length of time and the force of the subterraneous steams, were so rotten that after their being exposed to the air they fell to pieces almost upon touching, yet three of the teeth were found entire, which weighed an hundred ounces, and were by the inhabitants of Drapani hung up in one of their churches to perpetuate the memory of this fact. They likewise found part of the skull capacious enough to hold some bushels of corn, and one of the shank bones which was so large that upon comparing it with the shank bone of an ordinary man, it was judged that this giant, whom some took to be Erick, others Echellus, others one of the Cyclops, and again others the renowned Polyphemus himself, must have been two hundred cubits high; according to which calculation he is figured and represented by F. Kircher ^l as by far the largest of a whole gradation of giants, whom after this he places in the following order:

	Cubits.
The giant of Strabo, whose skeleton was dug up near Tingis in Mauritania and was found to be _____	60 high
Pliny's giant, found in a mountain in Creta _____	46
The skeleton of Asterius son of Anaetes _____	10
The skeleton of Orestes, dug up by special command of the oracle _____	7
The giant, whose bones were found under a large oak not far from the convent of Reyden in the canton of Lucern in Swisserland. _____	9
Goliath, as described in sacred writ _____	6 $\frac{1}{2}$

The case is still less doubtful with regard to those bones which were found in France in 1456, in the reign of Charles VII. by the side of a river in the barony of Crussolle (afterwards erected into a county) not far from Valence. Joh. Marius in lib. de Gall. illustrat. Cal-

ⁱ L. C. pag. 20. 6.

^k Genealogia degli Dei. l. iv. ad fin.

^l Mund. subterr. l. viii. sect. 2.

mæus in suis de Biturig. comment. Fulgosus in his Annals, and Joh. Cassanio of Monstroeul in his treatise of giants ^m, severally take notice of these bones, which were so large that the whole height of the giant to whom it was thought they belonged, and who was supposed to have been the giant Briatus, was conjectured to have been of fifteen cubits. The skull alone was two cubits thick, and the shoulder bone six cubits broad. Sometime after, other bones of this kind were found in the same barony near the same place, part of which Cassanio saw himself, and gives such a particular description of one of the teeth as leaves little room to doubt but that it was the grinder, and consequently the other bones the bones of an elephant. His words are ⁿ, “*Miræ magnitudinis dentem multi ibidem conspeximus, longitudine unius pedis, pondere librarum octo; multo autem oblongior quam crassus visus est, radicesque aliquot habere quibus gingivæ inhærebat. Visa est insuper ea pars qua cibus terebatur, aliquantulum concava, latitudine digitorum quatuor.*” He adds farther that such another tooth was kept at Charmes a neighbouring castle, that he measured the length of the place whence these bones were dug, and found it to be nine paces; that some time after more bones were discovered at the same place, and that the country all thereabouts was very mountainous, and such as the giants in all probability delighted to dwell and command in. I have seen some of these bones brought by a very curious French merchant from this last mentioned place, which I took to have belonged to an elephant, by some large cells between the tables of the skull, which are in the skull of that animal.

Hieron. Magius ^o gives an account of a very large skull eleven spans in circumference, and some other bones probably belonging to that skull, which were dug up near Tunis in Africa by two Spanish slaves as they were ploughing in a field. He was informed of this matter by Melchior Guilandinus who saw the skull himself when he had the misfortune to be taken by the rovers and carried into slavery to that place in the year 1559. I am the more inclined to believe that this skull and bones was part of the skeleton of an elephant, because, as I shall shew hereafter, a like large skeleton was dug up near the same place some time after, which by one of the teeth sent to Peiresk was made out to have been the skeleton of an elephant.

I now come to those bones, teeth and tusks, (or horns, as some call them) which are mentioned by authors to have been dug up in divers parts of the world, and have been made out by them, or do otherwise appear by their description and figures, indisputably to belong to the elephant.

Joh. Gorop. Becanus ^p, notwithstanding he lived in an age when

^m Pag. 57, & seq.

ⁿ Pag. 62.

^o Miscellan. lib. i. cap. ii. pag. 19. 6.

^p Orig. Antwerp. lib. ii. quem gigantomachiam appellavit, pag. 178.

the stories of giants were very much credited and had found their advocates even among persons eminent for their learning and judgment, yet ventured to assert that the tooth kept and shewn at Antwerp (as the tooth of that unmerciful giant whose defeat, brought about as they pretended by Brabo a son of Julius Cæsar and king of the Arcadians, was fabulously reputed to have given occasion to the building of that castle and city) was nothing but the grinder of an elephant. However displeasing this assertion might be, as Goropius farther adds, to those who are delighted with such idle and ridiculous stories, yet to the judicious it will appear the less surprizing, on account of what passed not long before he wrote this book, when the almost entire skeletons of two elephants, with the grinders and likewise the dentes exerti or tusks, were found near Wielworda (Vilvorden) as they were digging a canal from Brussels to the river Rupel, to defend that town and country from the incursions of those of Mechlen. Goropius conjectures that these elephants had been brought thither by the Romans, at the time either of the emperor Galien or Posthumus.

A very large skeleton, likewise of a giant as pretended, was dug up near Tunis in Africa about the year 1630, whereof one Tho. d'Arcos who was then at that place sent an account together with one of the teeth to the learned Peiresk. The skull was so large that it contained eight Meilleroles (a measure of wine in Provence) or one modius, as Gassendus calls it ^q, or a pint and a half Paris measure. Sometime after a live elephant having been shewn at Toulon, Peiresk ordered that he should be brought to his country seat on purpose to take that opportunity to examine the teeth of the creature, the impressions whereof he caused to be taken in wax, and thereby found that the pretended giant's tooth sent him from Tunis was only the grinder of an elephant. This is the second large skeleton dug up near Tunis in Africa, and it appearing plainly by the tooth sent to Peiresk that it was the skeleton of an elephant, it may from thence very probably be conjectured, some other circumstances concurring, that the other also which Guilandinus saw there must have been rather of an elephant than of a giant.

Tho. Bartholin ^r mentions the grinder or maxillar-tooth of an elephant, which was dug up in Island and sent to him by Pet. Resenius. It was turned to a perfect stony substance like flint, as was also the tusk of a Rosmarus dug up in the same island.

A large tooth, which by its shape appears plainly to be the grinder of an elephant, is described and figured by Lambecius ^s who had it out of the emperor's library, though he could not be informed where it was found or how it got thither. It weighed twenty eight ounces,

^q Gassend. in vita Peiresk. lib. iv. an. 1632.

^r Act. medic. & philos. Hafn. tom. I. obs. xlv. pag. 83.

^s Biblioth. Cæsar. Vindob. lib. vi. pag. 311.

and was commonly taken to be the tooth of a giant. Anton. de Pozzis, chief physician to the emperor, in a letter to Lambecius * affirms it to be an elephant's tooth, and conjectures that it was dug up at Baden, about four miles from Vienna, where but a few years before he wrote this letter they had found also the os tibiæ and the os femoris of an elephant.

Another tooth, probably of an elephant too, is described and figured by Lambecius †, who had it out of the emperor's library. It weighed twenty three ounces, and was found in the year 1644 at Krembs in the lower Austria, as they were increasing the fortifications of that place.

The year following when the Swedes came to besiege the town of Krembs, a whole skeleton of a giant, as was pretended, was found at the top of a neighbouring mountain near an old tower. The besiegers in their intrenchments there being very much incommoded by the water that came down from the mountains, dug a ditch three or four fathoms deep to lead it another way. In digging this ditch they found the skeleton aforesaid, which was very much admired for its unusual size. Many of the bones, chiefly those of the head, fell to pieces upon being exposed to the air, others were broke by the carelessness of the workmen; some escaped entire and were sent to learned men in Poland and Sweden. Among these was a shoulder bone with an acetabulum in it large enough to hold a canon ball. The head, with regard to its bulk, was compared to a round table, and the bones of the arms (or forelegs) as thick as a man of an ordinary size. One of the grinders weighing five pounds was given to the Jesuits at Krembs: another is figured by Happelius ‡ to whom I am indebted for this account, and it appears plainly by the figure of it that it is an elephant's tooth. It weighed four pounds three ounces Nuremberg weight.

Again, in Lambecius his *Bibliotheca Cæsarea Vindobonensis* §, are two figures and the description of a very large elephant's tooth which weighed 4 $\frac{1}{2}$ pounds. It was sent from Constantinople to Vienna in 1678, and offered to be sold to the emperor for two thousand rixdollars, having been before for its unusual size and pretended great antiquity valued at ten thousand rixdollars. They gave out that it was found near Jerusalem, in a spacious subterranean cavern, in the grave of a giant which had the following inscription upon it in the Chaldaic language and characters; "Here lies the giant OG"; whence it was conjectured to have been the tooth of Og king of Basan, who was defeated by Moses and who "only remained of the remnants of giants; whose bedstead was of iron, nine cubits was the length thereof, and four cubits the breadth of it, after the cubit of a

* Ib. lib. vi. pag. 315.

† Relat. curios. tom. iv. pag. 47. 48.

‡ Ib. lib. vi. pag. 313.

§ Lib. viii. p. 652.

"man".

"man²." As the whole story looked very like an imposition, the emperor ordered that the tooth should be sent back again to Constantinople.

Hieron. Ambr. Langenmantel, a member of the imperial academy of sciences, inserted into the Ephemerides of that academy an abstract of a letter to himself from Joh. Ciampini in Rome concerning some very large bones, to wit the shank bone, the shoulder bone, and five vertebræ, among which was one of the vertebræ of the neck, which were dug up near Vitorchiani in the bishoprick of Viterbo in the year 1687. They weighed altogether upwards of a hundred and eighty Roman pounds, and having been compared with other such bones in several collections at Rome, particularly the Chisian one, they appeared to be by far the largest. Most people took them to be the bones of a giant, but Ciampini and some others taking them, with more probability, for the bones of an elephant or some other large animal, and knowing that there was in the Medicean collection at Florence a compleat skeleton of an elephant, they procured a copy of it, and found upon comparison the abovementioned bones so exactly to correspond with it as to leave no room to doubt but that they had been part of an elephant's skeleton.

The skeleton of an elephant which was dug up in a sand-pit near Tonna in Thuringen in 1695 is one of the most curious, and also the most compleat in its kind, forasmuch as they found the whole head, with four grinders, and the two dentes exerti or tusks, the bones of the fore and hind-legs, one of the shoulder bones, the back bones, with the ribs, and several of the vertebræ of the neck. But the whole hath been so accurately described by Wil. Ernest. Tentzelius, historiographer to the dukes of Saxony, in a letter to the learned Magliabechi printed in the Phil. Trans. N^o 234. p. 757. † that it is needless to add any thing, the rather as that gentleman was pleased to oblige the Royal Society with some pieces of the bones of this elephant, with part of the skull wherein appeared its cells, some of the grinders and part of the dentes exerti; all which being produced at a meeting of the Royal Society were found exactly agreeable to his description and ordered to be carefully preserved in their repository. From the surface of the ground down to the place where these bones were found, the disposition of the strata or layers was as follows: a black soil four foot deep, gravel two foot and a half, the middle whereof was made up of osteocolla and stones to the depth of two foot, osteocolla and stones half a foot, a sandy clay six foot, with about two inches of osteocolla in the middle, osteocolla and pebbles one foot, gravel six foot, a white and fine sand the depth whereof was unknown, and in this the bones were found.

† Vol. II.
C. III. §. 37.

² Deut. ch. iii. ver. 2. ² Decur. ii. annus vii. s. 1683. obs. ccxxxiv. pag. 446.

In Marfili's *Danubius*, vol. II. where he treats of the antiquities he observed along this river, there is mention made of several bones and teeth of elephants which that inquisitive nobleman met with in Hungary and Transylvania, and which are now in his valuable collection of natural and artificial curiosities at Bologna. According to the best information the people of whom he had them could give him they were found in rivers, lakes and pools. One of the vertebræ, a grinder, and a considerable part of the dens exertus or tusk were found in the lake or pool of Hiulca. Two fragments of the os tibiæ a little corroded on the inside were taken out of a pool near Fogheras in Transylvania, once the seat of the princes of that country; and the whole lower jaw with two grinders yet sticking in it he had from some fishermen who found it in the standing waters by the river Tibiscus, a little above die Romerskantz or the Roman fort. All these the author caused to be figured as big as the life. I have above related the opinion of Goropius about the antiquity of those two elephants the skeletons whereof were found near Vilvorden, which he traces no higher than the time of the Romans and their expeditions into those countries, particularly under Galien and Posthumus. Count Marfili is of the same opinion with regard to those bones and teeth found by him in Transylvania. He takes notice that whosoever is acquainted with the vast use the Romans made of elephants in their military expeditions ought not to be surpris'd that there are bones and teeth found of them in those northern countries, where otherwise there cannot have been any; and he urges as a farther proof of this assertion that they are found in pools and lakes, it having been the custom of the Romans to throw the carcasses of dead elephants into the water, as it is still practis'd to this day with the carcasses of horses and other beasts, to prevent the distempers and other inconveniencies which their putrefaction might otherwise occasion. On the other hand there are many arguments taken from the largeness of the beasts, the skeletons whereof are thus found under ground, which sometimes far exceeds any that was or could have been brought alive into Europe, from the condition they are found in and from the particular disposition of the strata above the places where they are found; whereby it appears almost to a demonstration that they must be of much greater antiquity, and that they cannot have been buried at the places where they are found, or brought thither any otherwise but by the force of the waters of an universal deluge. To insist only upon one of these arguments: if the skeletons of elephants which are thus found under ground and at considerable depths too, had been buried there either by the Romans or any other nation, the strata above them must necessarily have been broke through and altered; whereas on the contrary several observations inform us that they were found entire; whence it evidently appears that what is found underneath must have been lodged there, if not before, at least at the very time

time when these strata were formed; consequently long before the Romans. But there is another argument which seems to me to bear very hard against the conjectures of Goropius and Count Marsili. Tentzelius hath already mentioned it, and it is urged from the great value of ivory at all times and particularly among the Romans, which appears by many passages in antient authors; as for instance by a very remarkable one in Pliny ^b, who takes notice that among the valuable presents which the Ethiopians were obliged to make to the kings of Persia by way of a tribute, there were twenty large teeth (unquestionably the dentes exerti) of elephants, and then adds, "Tanta ebori auctoritas erat." Now it is to be presumed that the Romans would not have neglected to take away the teeth and particularly the dentes exerti of dead elephants, before they flung their carcasses into the water; whereas there hath scarce been any skeleton, or any part of the skeleton of an elephant dug up any where, but the teeth were found along with them, and even among those figured by Count Marsili there are three grinders and a considerable part of one of the dentes exerti.

Dr. Rob. Plot ^c says that he was presented by W. Leveson Gower of Trentham Esq; with the lower jaw of some animal with large teeth sticking in it dug up in a marle-pit in his ground, and which upon comparison he found exactly agreeable to the lower jaw of the elephant's skull in Mr. Ashmole's museum at Oxford.

In the museum of the Royal Society there are two fossil bones of elephants: one was given by Sir Tho. Brown of Norwich, the other was brought from Syria for the os tibiæ of a giant, but Dr. Grew ^d proves by an exact computation that it can never have been the os tibiæ of a human skeleton, by being full twenty times as thick, and but three times as long. It is an English yard and half a foot long, and hath a foot in circumference where it is thinnest. Dr. Grew observes that by the figure it appears to have belonged to the leg and not to the thigh, and he conjectures the whole elephant to have been about five yards high.

Before I dismiss this subject I must beg leave to mention a few more. Gessner ^e takes notice that he was presented by a Polish nobleman with a tooth four times as large as that which he figured under the title of Hippopotamus in his book de Aquatilibus. It was found under ground as they were digging for the foundation of a house, together with a very large horn as they called it, which many took to be an unicorn's horn, but wrongly, as Gessner thought, because of its being too thick and too crooked. It is very probable that this pretended horn was the dens exertus of an elephant. The same author mentions a subterraneous cavern near Elbingeroda, wherein were

^b Lib. xii. c. 4.

^c Nat. hist. of Staffordshire Ch. vii. §. 78. pag. 78.

^d Musæum reg. soc. pag. 32.

^e De fig. lapid. pag. 157.

Worms found in the kidneys of Wolves. PART III.

found the bones and teeth of men and animals so large that it was scarce credible that ever any of that bulky size should have existed.

The grinder of an elephant petrified is kept in the king of Denmark's cabinet at Copenhagen, as appears by the catalogue ^f, but there is no mention made how it came thither or where it was found.

They shew in the same collection a large thigh bone, which weighs about twenty Danish pounds and is above three foot in length ^g. It is so old, according to the author of the catalogue, that it is almost become stony. The same author takes notice of another large bone then in the collection of Otho Sperling, which weighed twenty five pounds and was four foot long. It was, as Sperling told him, found in the year 1643 at Bruges in Flanders near the publick prison, in presence of Bern. de Arauda and Sperling's father, who saw the whole skeleton there, which was of twenty yards of Brabant in length.

A piece of ivory was dug up in a field on the river Vistula about six miles from Warsaw, which having been shewn at Dantzick to Gabriel Rzaczynski author of the Natural history of Poland, it seemed to him to be the dens exertus of an elephant ^h.

In the notes upon the last edition of Dr. Herman's *Cynosura medica*, published by Dr. Boecler of Strasburg ⁱ under the title of *Uncornu fossile*, there is mention made of a remarkable piece of fossil ivory, or rather of an elephant's tooth in the hands of Jacques Samson de Rathsamhausen de Ehenweyer an Alsatian nobleman. It was found in the Rhine upon one of his estates near Nonneville, and was three Paris foot three inches and a half long: it had near a foot at the basis in circumference where thickest, and about eight inches and a half at the other extremity. It was filled within with a sort of marle but the outward surface was stony in some places, and bony in others. The bony part scrap'd, or burnt, smell'd like ivory. The scrapings boiled made a sort of gelly. The author of the notes adds, that they find fossil ivory in several parts of Europe, particularly in the Schwartzwald (Sylva Hercynia) in Moravia, in Saxony, and near Canstad in the dutchy of Wirtemberg.

*Worms found
in the kidneys
of wolves. By
Theod. Klein.
To Sir Hans
Sloane, Bart.
n. 413. p. 269.
Mar. &c.
1730.
Fig. 30. 31.*

XI. **I** Here send you a description of some worms found in the kidneys of wolves, to which we commonly give the name of *vi pers.* They were sent to me from Sewaldia in E. Prussia.

Fig. 30 exhibits a female worm found in the kidney of a she wolf.

Fig. 31 is the kidney of a wolf resembling a bag, on account of the almost entire consumption of its parenchyma. It contained eight worms, some of a yellowish, others of a blood colour; two of which were females, six males.

^f Mus. regium part I. sect. vii. N^o 109.

^g Rzaczynski hist. nat. reg. Polon. pag. 2.

^h Ibid. part I. sect. i. N^o 73.

ⁱ 1726. 4^{to}. P. iii. p. 133.

The females were more than twice as long and as thick as the males. They were furnished with three very visible holes; viz. the mouth, the anus and the vulva; the last of which is seen under the belly about an inch and half from the mouth *a, b, c*.

Fig. 32.

The membranous skin was marked with annular fibres, and seven or eight chefnut-coloured lines *d*, running the whole length of the worm. The skin being cut a limpid humour issued forth, and then appeared the transversal fibres interlaid on every side with the viscera, and all round about inserted into the skin in the interstices of the vesicles aftermentioned, and at the same time the viscera appeared, which the sole parts destin'd for nutrition and generation seem to make up.

The alimentary passage is composed of two canals, one whereof *b, b*. which begins at the mouth and is about two inches long, smooth, fleshy, whitish, and endowed with thick coats, serves for receiving nourishment. As this duct proceeds with equal thickness, it is once reflected and retorted before it enters the other *c, c, c, d*. which is of a dark brown colour, much broader and tenderer than the first, flatted, membranous, covered with very fine coats, wrinkled like a swathing cloth, then runs into transversal and winding fibres, and extends in a strait line to the anus. The inner coat of this canal seemed somewhat rough, and as it were strewed with dust. The contained liquor was perfectly fluid, and of a faint sooty colour.

Fig. 33.

The organs of generation we found thus. Near the anus was fixed to the skin the end of a whitish tender vessel, which thence proceeded strait to the beginning of the alimentary canal, where reflecting towards its origin, and again resuming its first way, after being contorted and implicated in many and various windings and curves, widens and straitens here and there, until at length becoming more and more capacious it forms a little bag, for which a whitish, fine, smooth canal, about an inch long, covered with pretty thick coats piercing through the skin an inch and half from the mouth, prepares an outlet, marked under the belly with a caruncle (fig. 32 *c*. fig. 34 and 35 *b*.) This little canal may be not improperly called the oviduct or vagina.

Fig. 34, 35.

The colour of these parts is not every where the same; for of whitish at the beginning in the progress it insensibly becomes darker: and at length where the vessel becomes larger, and especially where it stretches forth into the bag it is of a chefnut colour. And as far as this chefnut colour continues, the vessel is thick stuffed with myriads of eggs, and therefore may be called the ovary.

The eggs, whose number is incredible, seen with the naked eye resemble a magma of a brown colour; but viewed through those microscopes which in the English apparatus bear the second and third number, they are of the figure marked *a* and *b*.

Fig. 36.

The surface of the inner skin which inclosed the abdominal contents was all beset with small whitish bladders of different figures and bulks, pouring out a lymph upon tearing them. These were in the females.

Though the integument of the male be marked with annular fibres, and as many chefnut-coloured lines as that of the female throughout its whole length, yet his external shape differs from that of the female. First, because he is much less. Secondly, because the third hole, viz. that under the belly, is wanting in the male. Thirdly, because the anus of the male is surrounded with a thick cartilaginous membrane of near an orbicular figure, about a line broad, externally convex, internally concave; on the middle of which appears a tubercle divided by a fine slit, which lets out the excrements and a very small capillary process *k*.

Fig. 37.

The cavity of the belly contained a limpid humour, the transversal fibres, the alimentary canals, and spermatic vessels.

The alimentary passages had the same situation and structure as in the female; the anterior canal was of a whitish colour, the posterior or wrinkled one of a pale brown.

The spermatic vessels were very white and slender, yielding when wounded a milky humour. They are divided into two small branches hanging out of a vermicular process (scarce an inch long) which lies in the belly, in that place where the alimentary canals are joined together, and leans on the side of the wrinkled canal by the help of the transversal fibres. These branches in their progress creeping above and below the canal of the aliments, are very often reflected, intorted and folded; one at length freed from its windings, stretches away strait towards the anus into which it is inserted in the shape of a pretty stiff vessel; but the other at the side of the wrinkled canal being pressed, collected, and equally inflected, almost through its whole extent, by the transversal fibres, ends in the opposite side, by an extremity pendulous in the belly not far from the anus.

The inner coat of the skin, just as in the females, is all covered with small whitish bladders turgid with lymph, but less in proportion to the lesser bulk of the worm.

Fig. 38.

We found under the wrinkled canal a certain whitish duct marked with the letters *b, b, b*, firmly connected to the aforesaid intestin by its finest part; but whose outlet or origin the tenderness of the intestin and fineness of the duct hindered us from tracing with exactitude.

These worms are here represented in their natural bigness.

Fig. 32. the shape of a female worm; *a*, the mouth of the worm; *b*, the anus; *c*, the vulva; *d*, the chefnut-coloured lines running along the worm's length.

Fig.

Fig. 33 *a*, the worm's mouth; *b*, the alimentary canal, which is white, carnous, &c. *c*, the alimentary canal, which is brown and flatted, and whose extremity is in the anus; *d*, the place where the canals join; *e, e, e*, the transversal fibres; *f*, the anus.

Fig. 34 and 35 *a*, the worm's mouth, *b, b*, the first alimentary canal; *c, c*, the latter alimentary canal; *d*, the place where these two canals cohere; *e, e, e*, the transversal fibres; *f, f, f*, the white vesicles turgid with lymph, with which all the inner skin is thick beset; *g*, the anus; *h*, the vagina; *s*, the oviduct; *i*, the outlet of the vagina, or the vulva; *k, k*, the ovary filled with innumerable eggs; *l, l*, the preparing vessels.

Fig. 36. the eggs viewed through a microscope; *a*, through the microscope, N^o 3; *b*, through the microscope, N^o 2.

Fig. 37. a male worm; *a*, the mouth of the worm; *b, b*, the whitish alimentary canal; *c, c*, the wrinkled canal of the aliments; *d*, the vermicular process of the spermatic vessels; *e, e*, a branch of the spermatic vessels along the side of the intestine, compressed by the transversal fibres, and inflected through its whole extent in a uniform manner; *f, f, f*, the windings and turnings of the spermatic vessels; *g, g*, the transversal fibres; *h*, the cartilaginous membrane surrounding the anus; *i*, the small slit in its middle; *k*, the very fine capillary process; *m, m*, the small bladders covering the skin.

Fig. 38. a male worm inverted and dissected about the anus, in order to see with ease the duct lying under the alimentary canal; *a*, the wrinkled alimentary canal; *b*, the whitish duct under the wrinkled canal; *c*, the spermatic vessels.

Fig. 39. *a*, the vermicular process of the spermatic vessels; *b, b*, the branches of the spermatic vessels freed from their windings; *c, c*, the same branches dissected.

Fig. 39.

XII. **A**T Milan I found a viper-catcher who seldom was without sixty or more vipers alive kept together in a room open at the top; he had them from all parts of Italy, and sold them dead or alive according to the uses they were designed for. Having got one day a female viper big with young, he gave me notice to see her manage her prey; whereupon we caught some mice, and throwing them in one at a time, amongst all that number of vipers (which were rather above sixty) there was none of them that in the least concerned himself about the mouse, till the pregnant female viper and the mouse interchanged eyes; whereupon the mouse startled, but the viper raised her head and turned her neck into a perfect bow, the mouth open, the tongue playing, the eyes all on fire, and the tail erect. The mouse soon seemed recovered of his fright, would take a turn or two and sometimes more pretty briskly round the viper, and giving now and then a squeak run with a great deal of swiftness into the chops of

Observations upon vipers. By Dr. C. J. Sprengell, n. 376. p. 296. March &c. 1723.

the viper, where it gradually sunk down the gullet. All this while the viper never stirred out of its place, but lay in a ring.

It is to be observed that no viper will feed when confined except a female viper impregnated.

The same I saw at Brussels, where a soldier had caught a large viper big with young. The house where I and some of my companions lodged was near the fish-market, where my landlord had a sow, and five small pigs of nine or ten days old. One of the pigs we caused to be bit by the viper in the tail, and in four minutes time chopped off the tail, the pig appearing to be sick and dizzy, and the remaining part of the tail being swelled; but I believe the bleeding saved it, for the next morning it was well again. The same happened to another pig which we had got bit in the fore foot, and staying seven minutes after the bite cut off his leg about two inches above the bite. After these two we took the other three, and had them bit in several places, whereof two died that night, and the third recovered, we having given it about five or six minutes afterwards ten grains of emetic tartar.

This I tried afterwards upon dogs bit by vipers, and I found that they all recovered upon the emetic tartar.

*An account of
the Rattle-
snake. By
Paul Dudley
Esq; n. 376.
p. 292. March
1723.*

XIII. 1. **B**Oth men and beasts are more afraid of the rattle-snake than of any other snakes; and while the common snake avoids a man, this will never turn out of the way.

There are three sorts or kinds of them distinguished by their colour, viz, a yellowish green, a deep ash colour, and a black sattin.

The eye of this creature has something so singular and terrible, that there is no looking stedfastly on him; one is apt almost to think they are possessed by some dæmon.

A rattle-snake creeps with his head close to the ground, and is very slow in moving, so that a man may easily get out of his way. His leaping and jumping to do mischief is no more than extending or uncoiling himself; for they don't remove their whole body as other creatures do when they leap; so that a man is in no danger of them if his distance be more than their length; neither can they do any harm when they are in their ordinary motion, until they first coil and then extend or uncoil themselves, but both these are done in a moment's time.

When a rattle-snake rests or sleeps he is coiled, and they are observed to be exceeding sleepy.

Our people at first took the noise this creature makes to be owing to some little bones or hard loose kernels lodged in their tails; but soon discovered their mistake, and found the tail to be composed of joints that lap over one another somewhat like that of a lobster; and the striking them one upon another forms that noise which is so terrible

rible to man and beast. The fiercest noise is observed to be in clear fair weather, for when it is rainy they make none at all; for which reason the Indians don't care to travel in the woods in a time of rain, for fear of being among these snakes before they are aware. One other circumstance of their rattling has been observed, to wit, that if a single snake be surprized and rattles, and there happen to be others near him, they all take the alarm and rattle in like manner.

I dare not answer for the truth of every story I have heard of their charming or power of fascination; but yet I am abundantly satisfied from many witnesses both English and Indian, that a rattlesnake will charm squirrels and birds from a tree into his mouth. A man of undoubted probity sometime since told me, that as he was in the woods he observed a squirrel in great distress, dancing from one bough to another and making a lamentable noise, till at last he came down the tree and ran behind a log: the person going to see what was become of him, spied a great snake that had swallowed him. And I am the rather confirmed in this relation, because my own brother being in the woods opened one of these snakes, and found two stript squirrels in his belly, and both of them head foremost. When they charm they make a hoarse noise with their mouths and a soft rattle with their tails, the eye at the same time fixed on the prey.

Their general food consists of toads, frogs, crickets, grasshoppers, and other insects, but principally of ground mice; and the rattlesnake again serves for food to bears, and even our hogs will eat them without harm.

They are viviparous, and bring forth generally about twelve, and in the month of June. A friend of mine in the country who had taken pains to discover the nature and manner of the generation of the rattlesnake, gave me the following account: About the middle of May, the time when the rattle-snakes first come abroad, he took and opened one of them, and in the matrix found twelve small globes as big as a common marble, in colour like the yolk of an egg; in three or four days more he took and opened another, and then plainly perceived a white speck in the centre of the yellow globe; in three or four days more he dissected a third, and discovered the head of a snake; and in a few days after that, three quarters of a snake was formed and lying round in a coil. In the latter end of June he killed an old one, and took out perfect live snakes of six inches long. In September, when the old ones take their young in and carry them to their dens, they are not quite a foot long. They couple in August and are then most dangerous.

I cannot say what other serpents or poisonous creatures may do, but I am satisfied the rattle-snake does not traject his poison; and that unless the skin be first broke or an incision made with his teeth his venom can do no harm; for my friend assured me that he had made

made an experiment of it in this manner: he took the breech of his gun and set it upon four or five of them, and after they had bit it and left several drops of their poison he with his hand wiped it off without any harm.

Our people have several remedies for the sting of a rattle-snake; among others that which is much made use of is a root they call blood-root; I suppose so named from the colour of the root and the juice which is red like blood. It grows in great abundance in our woods; they bruise the root and bind it above the place that is bit to prevent the poison's going farther, at the same time scarifying the place affected; some of the root is also boiled, and the person poisoned drinks the water.

They are generally from three to five foot long and do not commonly exceed twenty rattles; and yet I have it attested by a man of credit, that he killed a rattle-snake some years since that had between seventy and eighty rattles, with a sprinkling of grey hairs like bristles over his body; he was full five foot and an half long, and as big as the calf of a man's leg.

They shed or throw off their skins every year, sometime in the month of June, and turn it inside out when they throw it off. It has also been observed that the skin covers not only the body but the head and eyes.

They generally den among the rocks in great numbers together; the time of their retiring is about the middle of September, and they don't come abroad till the middle of May, when our hunters watch them as they come out a sunning and kill them by hundreds.

*Experiments
on the ef-
fects of the
poison of the
rattle-snake.*

*By Capt. Hall
to Sir Hans
Sloane Bart.*

*n. 399. p. 309.
July &c.*

1727.

XIII. 2. **M**AY 10 1720. in S. Carolina having got a fine health-ful rattle-snake about four foot long, I persuaded three or four gentlemen and one Mr. Kidwell a surgeon to assist me in making some experiments on the effects of its poison.

We got three cur-dogs, the biggest not larger than a common harrier, and the least about the bigness of the largest siz'd lap-dog, all smooth haired.

The snake being tied and pinned down to a grass-plat, we took the largest of them which was a white one, and having tied a chord round his neck so that it should not strangle him, another person held one end while I held the other; the length was not more than four yards each way from the dog.

Immediately on our bringing the dog over the snake, the snake raised himself near two foot and bit the dog as he was jumping; the dog yelpt, by which I perceived he was bitten; and upon it I pulled him to me as fast as I could, and perceived his eyes fixt, his tongue between his teeth which were closed, his lips so drawn up as to leave his teeth and gums bare: in short, he was quite dead in a quarter of a minute;

minute; but one person (beside my self) was of opinion it was in half that time. We could not see where the dog was bitten nor any blood: upon which we ordered some hot water to scald the hair off; when we could find but one puncture between his fore-leg and his breast, which looked of a bluish green a little round it.

Half an hour after the first bite we took a second dog which was somewhat less, of a liver-colour, and in like manner brought him over the snake which in a very little time bit his ear so that we all saw it; he yelped very much and soon shewed the signs of being very sick, holding that ear that was bit uppermost. He reeled and staggered about for some time; then he fell down and struggled as if convulsed, and two or three times got up wagging his tail though slowly, and attempting to follow a negro-boy who used to make much of him. We put him into a closet, and ordered the boy to look after him.

About an hour after the second was bitten we took the third dog in like manner: the snake bit him on the right side of the belly about two inches behind the long ribs; for we saw he had drawn blood there. The dog at first, I mean for about a minute, seemed not to be hurt; so we let him go, being one we could get again when we pleased. For that day we put up the snake, imagining his poison was very near if not quite expended.

In a little time after, which was just two hours after the second dog was bit, the boy told us he was dead.

About an hour after I persuaded Mr. Kidwell to open him, and I was in no small haste to examine the heart where I persuaded my self I should discover something extraordinary; but could not perceive any remarkable difference between that and many others I had seen where there was no poison in the case. Mr. Kidwell laid open the skull, and was of opinion that the brain was more red and swollen than any he had ever seen; and he told me a little while after that the blood turned very black.

For that day we heard no more of the third dog which was bitten; but the next morning the woman who owned him came to me complaining of my cruelty for killing her dog. She did not know when he died, but said she saw him at seven that evening which was about three hours after he was bit; and that he was so sick he could scarce wag his tail. None of these dogs were swollen before they died.

On the 14th we got two dogs both as big as common bull-dogs. The first dog, which he bit on the inside of his left thigh, died in half a minute exactly, in the opinion of two gentlemen who kept their watches in their hands all the while: there were two very small punctures in his thigh which looked livid though no blood was drawn. This dog did not swell for four hours after he was dead. I saw him and ordered him to be buried.

The second dog was bit about an hour after the first on the outside of his thigh, where we perceived the blood at two places: he soon sicken'd, and died in four minutes.

We thought his poison was not spent; so we got a cat (for we could get no more dogs) which he bit about an hour after though I can't say where. The cat was very sick and we put her up in a closet: by some means she was let out in less than an hour and a half after she was bitten. The next morning early she was found dead in the garden and much swoln; so that no body cared to examine or search where she was bit.

About a quarter of an hour after he had bitten the cat he bit a hen twice: the hen seemed very sick and drooping, and could not or did not fly up to her usual place of roost among the rest that night; but the next day she seemed very well and continued so till evening, when I ordered her to be killed and her feathers scalded off: there were two punctures in her thigh and a scratch on her breast over the craw, all which look'd livid.

About a week after having got a large bull-frog we brought that over him as usual: he bit it with much force; so that he seemed to fasten for a small space. The frog died in two minutes or thereabouts. In less than a quarter of an hour he bit a chicken which was hatcht the February before, that died in three minutes; I can't say where it was bit, and I was at a loss to try any further experiments for a long time for want of proper subjects. Dogs and cats were not to be had; for the good women whose dogs had been killed exclaimed so much that I durst not meddle with one afterwards.

About the middle of June I took him out according to custom, and having got a common black snake not of the viper-kind, about two and a half or near three foot long, in good health, just taken; I put them both together and irritated them so that they bit each other, and I perceived the black snake had drawn blood of the rattle-snake before I took them asunder.

In less than eight minutes the black snake was dead, and I could not perceive the rattle-snake at all the worse or sick.

June 30 I took him out to try whether if he bit himself it would not prove mortal to him. I hang'd him so that he was not above half his length on the ground; and with two needles at the end of a stick, one to prick and the other to scratch, irritated him so much that he soon bit himself, after having attempted to bite the stick many times. I then let him down, and he was quite dead in eight minutes or thereabouts, but am sure it did not exceed twelve minutes.

A gentleman persuaded me to cut the snake in five pieces which he gave to a hog, the head part first, in sight of many of us. The hog eat up all the snake, and ten or twelve days afterwards I saw the same hog alive and in health.

This was no more than I had seen before; but doubted they had taken some other snake for a rattle-snake: for being at the house of Charles Hart Esq; they shewed me a snake which a negro had killed just before. While I was looking on, a sow came and eat it up very greedily, tho' the negro endeavoured to hinder her. I never heard she was sick for it, and about ten days after I saw her in very good health. I have heard fifty relations of the same kind, and am told that those hogs which feed in the marshes will run after the common sort of water-snakes and will feed on them greedily: and in Maryland about two years ago I saw a hog eat up the head of a rattle-snake just cut off, while it was gasping very dreadfully; and I was told it was a common thing and would do them no harm.

June 10, 1723, a gentleman who practises physic at Charles-town sent to let me know he had got a fine rattle-snake which had been taken not above four days, about three foot and a half long, and that he designed to try whether he could save some of the dogs after the snake had bit them. He provided a quantity of Venice-treacle or mithridate, I can't positively say whether, which he divided into two potions each about two ounces; to one of them he put a large quantity of diaphoretic antimony. The first dog was bit on the inside of the thigh, and died in about half a minute, so that we could not get the potion down his throat soon enough to expect it could have any effect. Above an hour after, the second dog was bit and had two punctures in the fleshy part of the inside of his left fore-leg, which bled more than any I had seen before: we immediately forced down his throat the preparation with antimony. He soon grew very sick and strove to vomit, but I think brought up very little if any thing; he frothed at the mouth and bit at the grass which he champed as if he were mad; and indeed we were all afraid of him. We therefore put him into a room till next morning where I saw him as I thought recovered: we threw him some food which he eat, so we let him out and he went home. About a month after his hair came off and his master killed him because, as he told me, he looked like a leprous person; I never heard this dog swelled. The third dog was a shaggy spaniel which he bit about an hour and a quarter after the second, on the foremost part of his right shoulder, as we perceived by the blood. The dog seemed to bite at the place himself and was very sick for about two or three hours; but without any application he recovered, and I never heard he was sick afterwards.

XIII. 3. **T**HIS snake was placed in my hands on purpose to make such experiments with it as might inform mankind of the symptoms which attend its bite; and the appearances in the dead bodies of such animals as have been bit by it. It is only by this method and a number of facts faithfully stated and compared together, that we may hope to discover the manner of the poison's operating, and perhaps some remedy to relieve persons bit by it. The anatomy of the rattle-snake having been so accurately described by the late Dr. Tyson,

The poisonous apparatus of a rattle-snake with the quick effects of its poison. By J. Ranby Esq; n. 401. p. 377. Jan. &c. 1728.

Fig. 40.

Fig. 41.

Fig. 42.

very little more can be added to his account; I shall therefore only take notice of the instruments of its poison, some of which are different from what that celebrated anatomist observed. Removing then the common integuments of the head, the muscles that raise the poisonous fangs appear; the first of which arises with a short fleshy beginning from the upper edge of the lower jaw near the articulation of one of those bones which Dr. Tyson calls maxillarum dilatatores A, and sends a few carnosus fibres to the side of the cranium; then becomes tendinous and so marches to its insertion in the outside of the bone which receives the poisonous fang, fig. 41. Displacing this muscle there appeared a gland, fig. 40. B, about the bigness of a small pea, which I take to be one of the maxillary glands for the following reasons: first, the structure of the parts and its distance from the fang make it unlikely to be designed for separating the poisonous fluid, but rather a saliva to moisten the aliment in order to make it pass the oesophagus with ease, the stomach of those animals being but small and the gullet considerably larger; not without some analogy to the ingluvies or crop of granivorous fowls, where the food stops for some time and is moistened, before it is capable of descending into the stomach. Secondly, these parts are so contrived, that on opening the mouth to receive the prey (at which time such a fluid is most wanted) the muscle abovementioned pressing on the gland promotes the discharge of its contents into the mouth. The duct of this gland seems to open between the upper lip and the jaw, but as the excretory ducts of so small a gland are rarely to be seen with certainty, I won't pretend exactly to determine its aperture. Under this gland lies another muscle smaller than the former, which arises and is inserted near it fig. 40. C, these two muscles draw the bone fig. 40. D, in which the poisonous fang is fixed a little outwards and upwards. Between the last described muscle and gland passes a nerve to the upper part of the bone which receives the tooth fig. 40. E, and fig. 41. B, and it is probable that this nerve has been taken for the excretory duct of the gland beforementioned. Opening the mouth two small eminences appear in the forepart on the inside of the upper jaw, being a membrane raised by the fangs and drawn over them like the mouth of a purse fig. 42. A, B, fig. 41. C. This membrane is thick and strong, and placed in a microscope appears to have a number of glands, some of which are even visible to the naked eye. In a common viper I observed one on each side the fang. These membranes prevent the involuntary discharge of the poison out of the fangs (which in my opinion are the only repositories of that fluid) into the mouth, as also the killing with the fangs those little animals on which they sometimes feed. Putting back this membrane the fatal fangs appear, which on first view seemed to be only one on each side, till searching further there appeared four more; the first and largest is fixed in a bone which is articulated to the forepart of the upper jaw fig. 40. F. The

The four others are fastened in and covered with strong tendinous membranes, and lie as it were one over another fig. 41. A. fig. 42. C. and E. These teeth are crooked and bent in this form , especially the first, and have each two perforations the one on the upper part, the other at the lower part of its convex side; which last comes quite to the point and resembles the sloping cut of a pen. The upper perforation fig. 43. A. I imagine receives the poison, the other transmits it into the wound fig. 43. B. All these fangs are tubular, the largest of which contained a small quantity of a transparent fluid of a light yellowish colour, which on putting the snake into spirit of wine changed to a beautiful red; the fangs of the common vipers which I have examined had the lower perforation nearer the middle; freeing the mouth of the membrane, a muscle appears about the side of the first described above, which arises from the middle of the maxillarum dilatatores fig. 42. D. D. and is inserted on the under side of the largest tooth; for the force required to pull down the fang being less than to raise it, fewer muscles are required. This animal was in my custody about a month, during which time he bit three dogs and a cat; the two first were bit at the college of Physicians, and of these the first died about two minutes after the bite, and the moment he was bit he grew convulsed and lost the use of his limbs. The wounds were exceeding small and between the pectoral muscles. Upon opening the dog, the skin and membrana adiposa for the breadth of a crown were livid about the wound, as if from a violent blow. The second dog had the same symptoms with the first, but lived near a quarter of an hour and had bloody stools. Three days after, I carried the snake to bite another dog and cat. This dog was larger than either of the two former, and having been bit at the extremity of the nose he was immediately affected, howled, shook, fell down and foamed at the mouth; and in about ten minutes discharged his excrements involuntarily tinged with blood: he died in about two hours. The next day I opened the body and observed the abdominal contents very much inflamed, especially the stomach and intestines, which appeared nearly equal to the finest injection, and contained a mucous matter, mostly blood, and the fine villous coat which is so visible in these animals was entirely destroyed. About an hour before he was bit he had a plentiful meal of coarse beef, of which there was not the least appearance. Opening the thorax, the pleura and other membranes looked as if injected; the heart was turgid with blood, as were also its vessels. The vessels of the membranes of the brain made a most beautiful figure from the quantity of blood contained in them, as did likewise the blood-vessels of the nerves; there was a small quantity of water between the two hemispheres. The blood contained in the heart and its vessels was an even mass about the consistence of cream. The cat lived about five hours, and had upon opening nearly the same appearances.

Fig. 43.

*An instance of
the venom of
spiders. By
Mr. Tho.
Robie, n. 382.
p. 69. March
&c. 1724.*

XIV. **S**EPT. 13. 1722. one Nat. Ware of Needham in N. England was bit by a small spider a little above the ankle of his left leg. He could not give an exact description of the animal, having instantly crushed it to pieces: but about half an hour after he was bit he felt a pain in his leg, which in about half an hour more was got into his groin, attended with a creeping pain in the calf of the leg that was bit: about an hour after this he felt the pain in the small of his back, then all round him, particularly in his stomach and right thigh, succeeded by a numbness in his head. His pulse was very low and heavy, the pains not fixed, but erratic and very acute, so as to hinder him from sleeping in the night. Next morning, by the advice of a physician he took some sp. corn. cerv. and sal. vol. corn. cerv. with vin. viperin. and onions or garlic externally applied to the wound. These things raised his pulse, and so I suppose assisted nature to throw off the venom; for he found himself much better.

The following curious paper is extracted from a book entitled, *Histoire naturelle de la Cochinelle justifiée par des documents authentiques.* Amsterdam 1729.

*The natural
history of cochineal. By Dr.
W. Ruttie.
n. 413. p. 264.
March &c.
1730.*

XV. 1. **A** Dispute arising betwixt the author (Melchior de la Ruuscher) and a friend, concerning the substance of cochineal, the one maintaining it to be a small animal, the other the fruit or grain of a plant, the author took the pains to procure from Antiquera in N. Spain, where there is the greatest traffic for it, the attestations upon oath of eight persons immediately employed in propagating and managing it for many years. These shew, 1. that they are small animals with a beak, eyes, feet and claws; that they creep, climb, seek their food, and bring forth young, not changing their species as silk-worms, but producing their like, which are not larger than nits, but when come to maturity resemble in size and figure a dog's tick. Thus far is certain, but their manner of generating is doubtful, tho' it is commonly believed by those who cultivate them, that they are impregnated by a small butterfly bred upon the nopal, the plant upon which they live. 2. After winter, when these little animals can bear the open air, and those which they have kept in their houses are grown so large as soon to produce young ones, they put twelve or fourteen together into a pastle, or little nest made of fine soft hay, straw, moss of trees, or the down which immediately envelopes the cocoa nut. These pastles they place upon the plants of the nopal, or prickly Indian fig (which they take care to cultivate for this purpose) and in two, three or four days, these animals bring forth a great number of young ones; soon after which the mothers die. In the mean while the young ones coming out of the nests climb up the nopal, fix themselves to it, and suck its juice, which is their only nourishment, but don't eat the plant; and for this reason they always seek those parts of it that are greenest and fullest of juice, taking care at the same time to place themselves on the parts most sheltered from the wind

wind and weather. During this time, whilst they are growing up and become pregnant, great care is taken that no vermin incommode them, as also to keep them clean and disengage them from certain threads like cobwebs that grow upon the nopal, to defend them from too much heat or cold, from the rain and winds, because the fine cochineals are very tender: nevertheless the wild cochineals stand all these inconveniencies; but then they are so gritty, of so ill a smell, and of such little value, that they ought not to be mixed with the fine.

3. In regard to the gathering of the cochineal: the first is of the mothers, which having brought forth their young have died in the nests. Three or four months after this, as the season permits, when the young ones are become sufficiently large and are in a state to bring forth young in their turn, or have produced some few, the Indians carefully gather them off the nopals with a little stick, having some hair fixed to it in the nature of a pencil. These animals being collected in this manner, and afterwards killed by hot water or fire, this is called the second gathering, or rather the first of the young ones that have been nourished and raised in the open air. Three or four months after this they gather the second brood of those that have been born upon the nopal, which being become big have brought forth already some young ones. This they do much in the same manner as before, only now they take off the plant a great many young ones with their mothers, which makes this sort of cochineal be called *granilla*, from the number of small ones found in it. In the mean time they keep a number of these young ones alive upon the nopals, which they pluck up or cut, and lock up in their houses to nourish them during the rainy season. Lastly, These being grown large, they put them into the pastles and proceed in the manner above expressed in the second article. So that for the most part they make three gatherings in a year. 4. As to the manner of killing the cochineal: this is commonly done two ways, either in hot water or in *tamalescales*, which are little ovens made for that purpose, tho' some kill them by roasting them upon *comales*, which are flat stoves with fire underneath made use of by the Indian women to bake their maiz bread. These three different methods give the cochineal three different colours. The first renders them of a brown red; the hot water making them lose the white colour with which they are covered when alive. The second makes them of an ash-colour and marbled, or jaspered; both upon account of the natural white with which they are covered, and the red and transparent colour of the cochineal itself. The third sort becomes black, as if it had been burnt. Of the old ones which died after dropping their young, four pounds produce but one, when dried; but three pounds only of the living, which have been carefully taken off the nopals, being killed and dried produce as much.

This is the substance of what I can collect from the attestations, &c. which the author has printed and annexed at length; not only because they

they contain many particulars unknown hitherto, but that the curious may be assured of a thing which has been known but very superficially even by those who have embraced the opinion that the cochineals were really little animals. And that there may be always a standing evidence to evince the truth of these facts, he has thought fit to deposite the original attestations confirmed by the certificates of three magistrates and three public notaries, among the registers of the royal society, by the hands of Mr. East a member of our body.

The natural history of the Coccus Polonicus. By Dr. R. M. Massey. n. 421. p. 216. Oct. &c. 1731.

XV. 2. **T**HIS account is extracted from the *Historia naturalis cocci radicum tinctorii* published by J. P. Breynius.

He calls it radicum, because it is chiefly found adhering to the roots of the polygonum cocciferum, † *Kosmaczek Polonis C. B.* This he takes to be the *Polygonum Germanicum*, *incanum*, flore majore perenni Raii. The Coccus, he says, is found sometimes single, sometimes even forty adhering to one plant, from the size of a poppy-seed to that of a white pepper-corn. It is roundish, smooth, and of a purple violet colour, and in a thin cuticle incloses a blood-red succus: one half or more of it is covered with a rough, dark-brown crust, by which it adheres to the roots. The countrymen gather it about midsummer, and dry it with a slow fire in earthen platters. He exposed several to the sun in open glasses, and found that by the 24th of July every one had excluded a small worm with six feet. That part which seemed to be the head had two short carnosæ antennæ; for he could not perceive with glasses any thing like either mouth or eyes. On the back length-ways were two sulci, which were more or less visible according to its different motions. Its feet seemed armed with claws, the first pair stronger and darker than the rest. The whole was of an obsolete purple colour, and had several bristles of a brown grey. After ten or fourteen days they lay in a state of rest, and soon became covered with an exceeding white and fine lanuginose substance; in which condition they continued five or eight days longer, and then laid their eggs, fifty, one hundred or more a-piece; which to the naked eye appeared but like so many red oblongish points, but with glasses looked like ants eggs, almost transparent, with a diluted blood-red content. These eggs being again exposed in the sun about Bartholomew-tide, in a month some vermiculi were excluded, which in the microscope appeared to be hexapods of a purplish hue, with two antennæ at their head, and two greyish bristles at their tails, scarce visible except upon black paper. He supposes these last excluded vermiculi fix themselves to the roots of the polygonum, where by some way or other they imbibe from the plant their blood-red succus so useful in dying.

Observations on wasps and the difference of their sexes. By the Rev. Mr. Derham. n. 382. p. 53. March &c. 1724.

XVI. **I**N July 1723. being on the top of the chappel in Windsor castle, I observed many wasps frequenting some pieces of timber on the leads. Most of them were larger than usual, and I

† *Kosmaczek Pilosella. Herbar. Polon.*

imagined

imagined they came thither to gnaw the wood and carry it away to build their nests; the artifice of which I have taken notice of in my *Phys. Theol.* ^k. But having caught some of them, and amongst the rest a large queen-wasp, I began to be more strict in my observations, and on July 6. I observed a cluster of only three wasps closely embracing each other; one of which was a large female, the other two of a lesser sort. This more excited my curiosity: and soon after I found eight or ten of them closely hanging together, and divers other such parcels. In the midst of all which was constantly a queen-wasp, and only one; the rest being always of a different sort from either the queen or the common wasps; which gave me a suspicion of their being male and female. And therefore examining another company of them with greater strictness, I found the queen-wasp in coitu with one of the other wasps, and so closely joined tail to tail that it was some time before they were parted. After this I caught all the wasps I could, but saw none of the common labouring wasps among them; but all were for the most part males with now and then a queen or female, and she generally in coitu.

From this history of my observations it appears, that there are three sorts of wasps; the queens or females; the kings or males; and the common labouring wasps; each of them very distinct. The queen or female-wasp (by many called the king-wasp) is much longer and larger than any of the rest. The males are less than the queens, but as much longer and larger than the common wasps, as the queen is longer and larger than these. These males also have no stings, which the queens and common wasps all have. And these are those which *Moufet* saith authors call *Ακέντρες* and take to be females, although he is of another opinion, imagining all wasps to have stings, because when he examined a wasp's nest at Ham in 1587. he found none without a sting. But I wonder how that curious enquirer missed of these sting-less male-wasps. Surely he was too hasty in his examination, and not being aware of the difference, he thought the males (which are but few in number to the labouring wasps) were the same and had stings as well as the rest, or else he made his enquiry at a time when perhaps the males had deserted the nest, which probably they may do, as the male or drone-bees are forced to do; or else the year 1587 might produce fewer wasps, at least fewer male-wasps, than 1723 did, which was observed to have a greater abundance of wasp-nests than hath been known in many years. In all the nests that I searched I constantly found male-wasps, many or few, according to the size of the nest and the number of wasps. The part of the nest where these males are bred, or at least where I gene-

^k B. 4. Ch. 11. note 21. and Ch. 13. note 12.

rally found them, was chiefly the two uppermost partings between the combs, but one.

Another thing by which the males may be known from other wasps is their antennæ, or horns; which are longer and larger than either those of the queen, or the common wasps; and with them they seem in running to feel more than the others do. But the chief difference is in their parts of generation, which are quite different from other wasps. I dissected them with all care, and shall describe them as well as I can.

If the alvus be pressed, an horny or shell-like part will be thrust out, of a shining black colour, which consists of two parts somewhat resembling the castagnets used in dancing; at the extreme part of each of which grows an hook somewhat like those of the ear-wig's tail, but much less; in the middle between these hooks appear three parts, the middlemost of which is a stiff brown tube very curiously made, with the forepart like a spoon or ladle, and the other end (within the body) neatly branched and braced to each side within the two shells abovementioned. A little above which branching is a *φυμάτιον* or swelling, like that of a dog's pizzle, and perhaps for the same use, if this tube is (as I imagine) the penis of the wasp. On each side this penis lies a stiff part branched at the top with somewhat like hairs, giving them the resemblance of brushes: at the bottom of which are two curious black cells, with an opening on one side like that of the concha veneris, small whitish hairs growing on one edge thereof. What the use of these two brush-like members may be I know not, unless to strengthen or direct the penis in coitu, or provoke therein. Behind all these parts farther in the body lies a long contorted white vessel; which at first I took to be the real penis, penetrating the ladle-like tube I spake of. But upon farther examination I rather take it to be the spermatic vessel. The use of the two little hooks at the end of the uropygium or shells I judge is to catch hold of the female's podex, and to direct and assist the penetration of the penis in coitu. As for the parts of generation in the female wasps, nothing was to be seen so remarkable as in the male; but they are very like what we see in the common labouring wasps: indeed, by the most accurate observations I could make with my microscopes, I could not perceive any difference at all. For which reason I suppose it is that most of the writers upon wasps and bees are very confused and wavering about the sexes of these two tribes of insects. It would be endless to cite the authors and their opinions, especially concerning the bee-tribe. Swammerdam¹, as he was one of the first

¹ Swam. Hist. insect. p. 92.

that rejected equivocal generation, so was he one of the most judicious writers of insects; and his opinion I think is the justest, viz. That of bees there are three sorts, "1. Rex, aut verius regina, si-
"quidem sequioris sexus est. 2. Fuci, qui masculi proprie sunt.
"3. Apes operariæ, quarum sexum distinguere non possumus, cum
"in iis nec masculas nec fœminas partes observemus: quæ perbellè
"distinguuntur in fucis seu regibus, & reginis quæ tralatitio errore
"reges solent salutari. In reginis certè invenimus ovarium apud in-
"comparabilem illum anatomum Joh. van Horne.

As for what is related by antient authors, or by our more numerous moderns, concerning the production of wasps out of horses, or bees out of oxen or young bullocks; as also of their polity, their emperors, kings, dukes, and common subjects, their exact discipline and justice, their strict temperance and other virtues, with a deal more of such like stuff: this is so very whimsical, that it is not worth while to take any farther notice of it. But there is a story seriously told by Moufet^m that deserves our observation: That "in the year 1582, be-
"ing on the highest ridges of the Cartmel-hills (I suppose in Lan-
"cashire) he saw among the rocks two species of wasps desperately
"fighting: that they differed only in magnitude; that the larger
"trusted to their strength; and the less to their numbers, there
"being six of the less engaged against only one of the larger size,
"and that the battle was not in the air but among the grass,
"and lasted for some hours in the hottest sun, not being at an
"end in two or three hours space." The cause of this engage-
ment Moufet thinks was, that the great wasps are wont to rob the less of their honey and young, or do them some other such like mischief; and the less being very revengeful and naturally full of courage did outbrave even Mars himself in assaulting their enemy. But this engagement I take to be such another as that which I have given the history of, namely under the conduct of Venus, not of Mars. And as there is no doubt to be made of its being such, and that the engagement seen by Moufet was on the highest tops of Cartmel (in summis Cartmeli montium jugis) as that I saw was on the very top of our chapel; it may deserve observation whether the wasps ever copulate in lower places obvious to disturbance and every one's eye, or only on such eminencies where they can be more out of sight, and consequently in greater safety: and if at any time they should be found in copulation, they may all with safety be seized with the naked hand, provided it can be secured against the queen-wasp, which is the only one in the company that is provided with a sting.

I shall conclude these observations with an experiment of Moufet's:
"If you take a wasp by the feet and suffer her to buz, those wasps
"which have no stings will fly to her, but none that have stings.
"Which some, he says, use as an argument to prove that some wasps

^m Moufet Theat. Insect. l. 1. c. 8.

"are males, some females." This experiment I was minded to try with a queen-wasp more especially, not knowing but that wasps, particularly the males, might be as fond of their queens as the bees are of theirs, who will not forsake them but will live and die with them. But I did not find it to succeed so among the wasps. For although I put some queen-wasps and others also near the entrance of some large wasp-nests, yet I did not see any flock near them, only now and then one of the common wasps for a little while. But indeed the queen-wasps which I confined, were weak and did not buz long; as also the time of copulation was probably past, it being August 12. when I tried the experiment.

Of the *Scarabæus galeatus pulsator*, or
Death-watch.
By Mr. Hugh
Stackhouse. n.
385. p. 159.
October &c.
1724.
†Vol. II. P. II.
C. VI. §. 29.

XVII. MAY 16. 1724. as I stood in my study I happened to hear what is commonly called the Death-watch, very near me as I thought. This brought into my mind what I had formerly read in the Phil. † Transf. N^o 245. of the *Scarabæus Galeatus Pulsator* described by Mr. Ben. Allen. While I was thinking upon the account there given, I fancied I heard the beatings somewhat stronger than before, which encouraged me to search after it; I thereupon removed to another part of the room, and soon discovered that I had pass'd the place where it was; I placed myself therefore about the middle distance, where though the beatings were not so frequent as before, yet I found I was somewhat nearer them, and fancied it was over my head toward the ceiling of the room; upon this I got upon a chair that had a sedge bottom, but then I could hear no beatings at all. I then stept down from the chair, and after I had stood still for some time, the beatings began again; this made me conjecture that they might be about the chair, and that my standing upon it might prevent them. Upon inclining my head down toward the chair I found I was still nearer and nearer to the sound, and at last placing my ear close to the sedge bottom I discovered that it was still further towards the ground: upon that I turned the chair's bottom upwards, but heard no beatings for a considerable time after; at length they began again, and as I cast a diligent eye over the bottom of the chair, I happened at last luckily to perceive the insect beating. I was very much pleased with the discovery, and stood viewing it beat for some time; afterwards I called up others to see it beat, which they did with admiration. The manner of its beating was thus. It lifted up itself upon its hinder legs, and somewhat extending or rather inclining its neck, beat down its face upon the sedge with great force and agility; the sedge upon which I found it, was bared of its outward coat for about the length of half an inch; the insect stood upon the inward bulbous part and beat upon the outward coat, as if it had been working it off as it went; the impressions of its strokes were very visible, the coat of the sedge being depress'd where it had beaten, for about the compass of a silver penny. Whether it beat for

for exercise or food I cannot say ; but very probably it might be for the latter ; and I am rather inclined to think so, because there were several places upon the sedge where it had been at work, and where, 'tis likely, it might have been a sojourner for some days.

As to what the ingenious Mr. Derham of Upminster has observ'd, Phil. † Transf. N^o 271. that the beatings are a sort of prelude for copulation, I could not discover that this beetle had any other of the same species near it ; and therefore I am inclined to think that it beat for the preparation of its food, at this time at least, whatever it might do at other times for pleasure. The description Mr. Allen gives of the insect referred to above, as far as I can find by this (which I took from the chair and put into a box) is very true : 'tis about a quarter of an inch in length, of a dark dirty colour, having a broad galea or helmet over its head, which it draws up under it when quiet ; so that this galea is, when the insect rests, a very notable defence against such falls as are frequent in rotten and decayed places, where probably this insect is very much conversant. The second day after I took it I opened the box wherein it was and set it in the sun : the insect was soon very brisk, and crept backwards and forwards along the pieces of sedge and rotten wood that I had put with it into the box, till at length getting to the end of one of the pieces it immediately struck out its wings, and was just going to take its farewell ; but having the lid of the box ready in my hand I shaded it over, and it soon drew in its wings and was very quiet. I could not before perceive, though I had the use of a tolerable good glass, any the least sign of a fissure upon its back ; and for that reason did greatly question whether it had any wings or not, till I set it in the sun. The head of the insect appears to be of a very fine contexture, as it is seen when it creeps about and stretcheth it forward ; but when it is drawn up under its galea it seems to be covered with a membrane thick set with fine hairs. It lived with me about a fortnight, but I could never perceive that it beat, after it was confined in the box.

† Vol. V.
P. I. C. I.
§. viii.

XVIII. 1. **H**AVING separated the muscles of the abdomen, which in this subject were only two oblique pair, we observed between their tendons, which were very strong, and the peritonæum, which was exceeding thin, a thick layer of sevous fat, whose office, considering the smallness of the epiploon, and the few adipose vesicles of the mesentery, with the thinness of the peritonæum, might probably be to supply the part both of epiploon and mesentery in other animals, as to lubricating the intestines.

*An ostrich
dissected. By
Mr. John
Ranby n. 386.
p. 223. Jan.
1725.*

There were in our subject two distinct ventricles, contrary to the observation of the Royal Academy at Paris. The first, and in its natural situation, the lower, which the members of the said academy call the *craw* and suppose to be only a dilatation of the œsophagus, was considerably larger than the second and uppermost muscular one ;

besides that it had strong muscular fibres both circular and longitudinal: the duodenum comes immediately out of the second ventricle.

Both ventricles were distended beyond their usual form, and filled up with so many things of different kinds, as stones, bones, sticks, grain, and other food, that it was almost impossible for them to perform their office of digestion, which very likely was one of the chief causes of the animal's sickness and death; and really the contents of both seemed to have undergone but very little or no alteration. The epiploon partly covered the first ventricle, but was no ways proportionable to the size of the animal.

The spleen was fastened by a membrane to the right side of the second ventricle, and was very small considering the size of the animal.

The glands of the mesentery were hardly visible, but the veins and arteries very conspicuous.

The cæcums in our subject were near three foot in length, the diameter one inch eight lines; they were fastened to the ileum, and not to the colon as the gentlemen of the Royal Academy assert.

To their description of the kidneys I have nothing to add, except that the two ureters lay upon their surface as they do in other birds, and that their different branches coming from all the parts of the kidney, of which the superior was very conspicuous, entered the kidney about its middle and formed there a very large pelvis.

The liver was in one cavity with the heart, of which it covered near one half; it had no gall bladder, and but one ductus biliaris inserted into the duodenum about two inches below the pylorus, which seemed to have an immediate communication with the vena portæ, because by blowing into it this latter was also distended. The heart and liver were separated from the intestines by a membranous diaphragm.

Both heart and liver were suspended by one common mediastinum by the help of its several membranes, and eight strong muscles on each side arising from the upper part of the ribs, going from thence over the lungs and ending in a very strong tendinous membrane, which is inserted into the spina dorſi.

The liquor contained in the pericardium was small in quantity and perfectly transparent.

The lungs lay under the diaphragm and its muscles in a deep cavity formed by the five true ribs. They were pretty thick about the middle, and exceeding thin and sharp towards the extremities.

In viewing the eye externally it somewhat resembled the human eye, except that it was less convex, with a free and moveable upper eye-lid, with eye-lashes as most terrestrial animals have, besides a tunica nictitans as in other birds. Besides the seven muscles of the eye as they are in brutes, it had two more, one arising from the forepart of the sclerotica, which soon formed a small tendon obliquely surrounding the optic

optic nerve, and then joined to another muscle which arises opposite to the former, from which the tendon continues its way and is inserted in the tunica nictitans. The aqueous humour we found in greater quantity than is common. The crystalline was of an uniform substance, but less convex on the inside than without. The vitreous was small in quantity, considering the largeness of the eye; the choroides was entirely black, without that variety of colours at its bottom which is common to most brutes. The forepart of the sclerotica, where it is annexed to the cornea, was bony, consisting of fifteen bony scales joined one to another so as to make one circular bone round the cornea.

For a more particular description I refer to the anatomical accounts given by the Royal Academy at Paris in their Natural history of animals, and by Vallisneri professor at Padua, in his *Notomia del Struthio*.

Fig. 44. shews the upper part of the thorax, the sternum being removed, with the heart and liver and neighbouring parts in their natural situation. Fig. 44.

A A. the membranous diaphragm, in which are observed several distinct cavities.

a a a. The ligament that suspends the diaphragm.

b b. The ribs.

B. The heart. C C. The two lobes of the liver immediately above the heart.

c c. The brachial artery.

d. The vein.

e e. Vena cava.

f. A gland on the brachial artery.

g g. Part of the aspera arteria.

h h. Part of the oesophagus.

i i. Two muscles arising from the sternum, and inserted into the asperaarteria.

Fig. 45. the inferior part of the thorax, the heart and liver being removed. Fig. 45.

A A A. The lower part of the diaphragm immediately covering the lungs.

B B, &c. Eight strong fleshy muscles arising from the ribs, and inserted into the diaphragm, forming a cavity for the heart and liver.

c c c. The ribs. D. The descending trunk of the aorta.

E E. The left lobe of the lungs freed from the diaphragm.

F. Part of the aspera arteria.

Fig. 46. part of the globe of the eye.

a. The cornea.

b b. The ciliary ligament.

c c c. The forepart of the sclerotica composed of fifteen bony scales.

Fig. 46.

The

- Fig. 47. Fig. 47. the backpart of the globe.
 a a a. The backpart of the sclerotica.
 b b b, &c. The seven muscles.
 c c c. The eighth and ninth; the tendon of which (*d d*) goes round the optic nerve *f*, and is inserted into the tunica nictitans.
 e e. Membrana nictitans.
- Fig. 48. Fig. 48. the kidneys with their vessels.
 A A. The kidneys,
 B B B. Aorta descendens.
 C C. Vena cava.
 D D. The emulgent arteries.
 E E. The emulgent vein with its ramifications.
 F F. The ureters.
 G. The union of the superior and inferior ureter.

Material observations upon dissecting an ostrich. By the same, n. 413. p. 275. March &c. 1730.

XVIII. 2. **T**O the preceding account I beg leave to add two or three observations which escaped my notice in my former dissection. And first, the eye, the figure of which when taken out of the orbit I think particular, being almost triangular, with some little variation in the bony-scales from my former description of it.

The contents of the stomach were of such a kind, that they were hardly capable, without very great alteration, of passing the lower orifice, which is very small.

The diameter of the duodenum much smaller than any of the intestines, and free from valves, as are the jejunum and ileum, except that the latter has a few valves, as it approaches near the colon. The colon was uneven, with very regular cells; these cells were formed by valves, which were on the inside and transversely situated, each making more than half a circle.

The parts in other respects answer the description given by the several curious gentlemen that have dissected this animal.

Observations upon the dissection of an ostrich. By Mr. G. Warren, n. 394. p. 113. May &c. 1726.
 † Vol. II. P. II. Ch. VI. §. xciv.

XVIII. 3. **D**R. Brown has so well described the parts of the ostrich in Philos. Collect. N° 5 † that I think there is not much to be added. Yet he affirms that it has no epiglottis; but in this subject (which was a male) that cartilage was plainly visible; and indeed the rimula appeared too open not to require one. The os hyoides is three inches long from the basis; the muscoli directores asperæ arteriæ were very plain, large and strong; the ring composed of three cartilages at the divarication of the aspera arteria very bold; the two glands on the carotid arteries as large as small eggs. There was nothing in the lungs or heart but what it has in common with other birds. The two stomachs, viz. the crop and gizzard, were filled with half digested grass, in which were some nails, some stones of the bigness of walnuts, and about fourteen or fifteen pieces of silver and copper money. The first stomach or crop was exceedingly

Fig. 31.



Fig. 30.



Fig. 32.

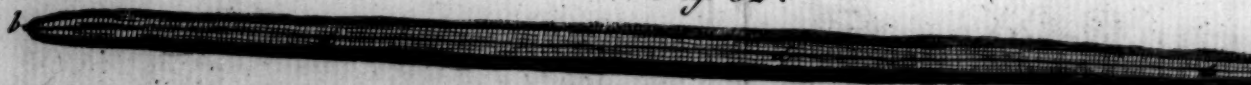


Fig. 33.

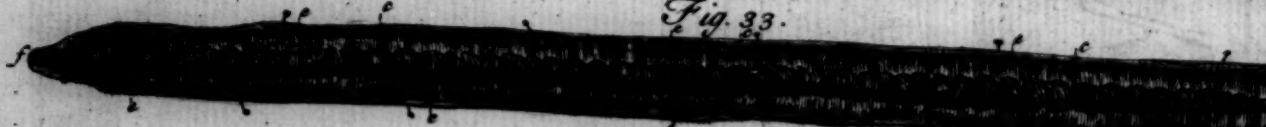


Fig. 34.



Fig. 35.

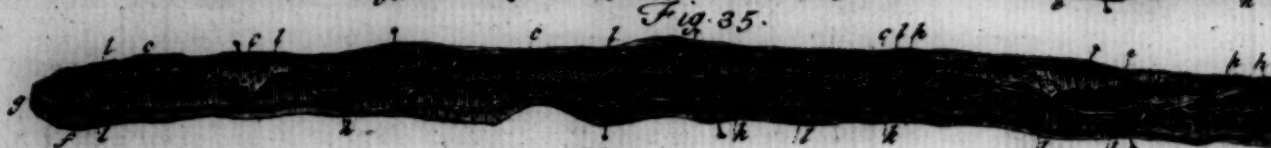


Fig. 36.

Fig. 37.



Fig. 38.

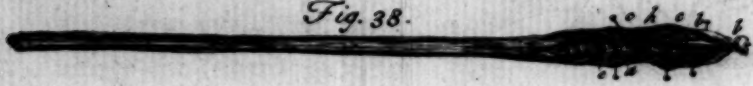


Fig. 39.



Fig. 40.

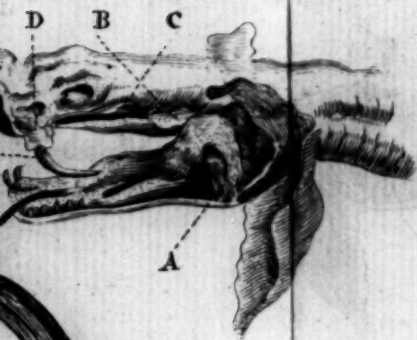


Fig. 41.



Fig. 42.

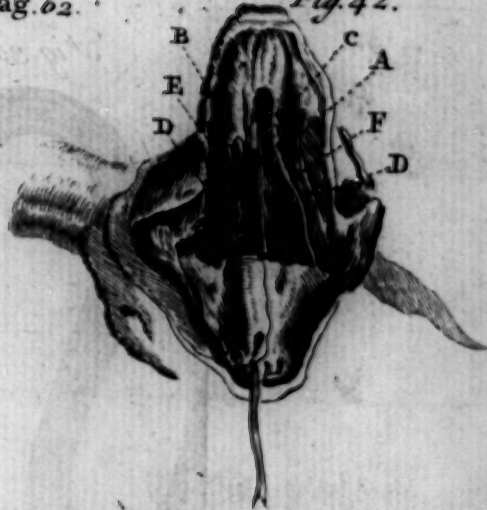


Fig. 43.



Fig. 44.

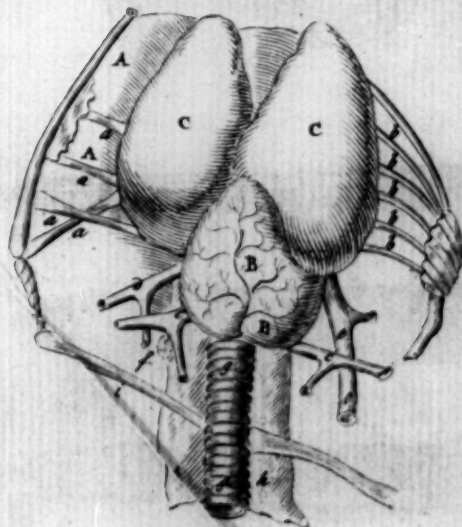


Fig. 45.

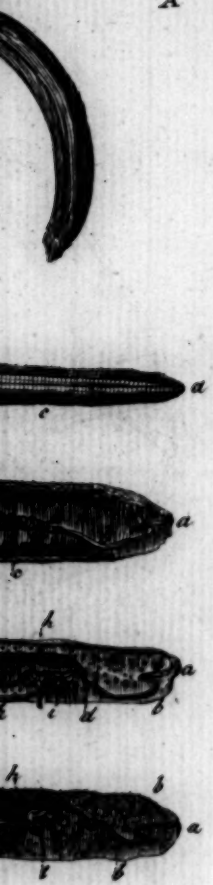
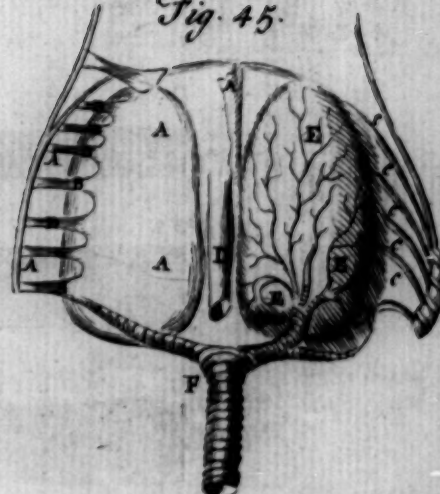


Fig. 46.



Fig. 47.

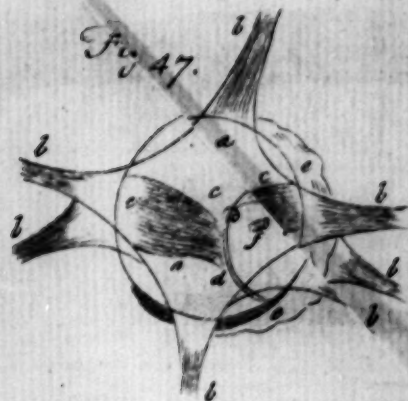


Fig. 48.



J. M. Wynne sc.

ingly tender, and contained, crammed as it was, between three and four quarts. The glands on the top of the crop were very large and numerous, in the order describ'd by Dr. Brown, and of the bigness of little oculi cancrorum, and of a watery brown colour; which being so different from the colour of the stomach, that added to the pretty order they are placed in makes them very remarkable. The crop lay within the thorax, but so that the gizzard lay higher. The looseness and likeness to flannel of the inner coat of the gizzard mentioned by Dr. Brown, was very remarkable in this bird; but the texture in the muscular part of it did not seem proportionably strong to that in other birds, being broader, thinner, and more flaccid. The guts, as near as I could measure them, were about twenty six yards long. The two cæcums which are about thirty four inches long each, and which have beautiful spiral valves, were appendages of the very beginning of the colon. The testicles lay as in other fowls, very high, and less than pigeons eggs, but longer. I found the liver to have four lobes, and thought I had met with a gall-bladder, but it appeared at last* to be only the membrane of the liver raised by some accident from its inner substance. The gland under the stomach, which Dr. Brown supposes to be the spleen, and the pancreas and kidneys answer his description; and the ureters were, as he says, firm, strong, white, long, and opening into the rectum. The eye is said to be exactly like the human eye; but is indeed a perfect goose-eye for its colour; and, I believe, for the rest of its parts, as they are well described by Mr. Ranby*: it was flatter than the human eye, as, I believe, those of all birds are; and it had that simple look so peculiar to the goose. The bony circle, described by Mr. Ranby this bird has in common with other fowls both of the water and land, with this difference only that the ring in water fowls consists of fifteen, and in land-fowls but of fourteen bones. They are so disposed that one bone lies over the ends of two others, then three or four lie over one another like the scales of fish; then one bone lies under the ends of two others; and then two or three more follow again like the scales of fish: but unless there be a *lusus naturæ*, I think Mr. Ranby's figure does not express it so very justly as I believe it might be done. There was no *musculus suspensorius oculi* in this animal, nor do I believe it is to be found among birds, and indeed there seems to be no reason for it. • §. XVIII. r.

The crop was so stuffed with grass, or other greens (proper food for a goose, or one of that kind) that I don't think the bird could have digested it off, if there had been no other reason for its death. The gizzard was not so stuffed as the crop, and what was therein seemed undigested. The guts contained a thick deep-green juice, even to the cloaca. The money both of silver and copper in the gizzard was very remarkably worn away; the edges, in particular, were made round, and the bust and reverse scarce perceptible in some pieces,

pieces, and quite obliterated in others. The ærugo and sulci in many of the pieces would make one believe (that besides the attrition) there may be a menstruum in their gizzards not unfit to dissolve metals. Within an inch of the end of the rectum was the cloaca, or expansion of that great gut, which was thinner than the other part of it in proportion to its expansion, and would hold above half a pint. The end of the rectum (from the cloaca) opened into a cavity big enough to hold my two fists; and for want of another name I will call it the receptaculum penis, because therein the penis was always lodged when flaccid. I know that part is called by Dr. Brown a kind of prepuce; but upon dissection it appeared plain enough to me to be a very strong muscle composed of circular fibres, and to be designed for a sphincter of that part wherein the penis was to be lodged, and to be a sphincter of the rectum too; round which I traced the same muscle above an inch; and this being but one muscle must be the reason that the penis always came out some inches when it mated, as they told me it did. The penis, flaccid as it is, is five inches and an half long from the skin of that receptaculum, and, as Dr. Harvey says, not unlike an hart's tongue. I don't find a cartilage in it, as Dr. Brown suggests; but at its origination it is so hard that I believe if the bird had lived some years it possibly might have become cartilaginous. There are two bodies that are joined to the crura penis, which I suspect to be the vesiculæ feminales; and the more because there are two vessels enter them, which I believe to be the vasa deferentia; but of this I am not certain: for though I found semen in the urethra, I have not been able to trace a passage from these supposed vesiculæ feminales, or those vessels, or any other part into the urethra. I call it urethra, because there is no other term fixed that I know of, tho' the urine does not pass that way; but, as in other birds, is mixed with the grosser excrements in the cloaca. The urethra then is only a sulcus, or gutter, from one end of the penis to the other; which sulcus, as the penis lies flaccid in the receptaculum, as I venture to call it, lies on the one side; but upon erection the penis turns towards the belly, and the sulcus is then uppermost, and lies conveniently enough for conveyance of the semen. If those two bodies are not the vesiculæ feminales they must be elongations of the crura penis; but I think they are of much too loose a contexture to serve that purpose. Whether the vena cava, dividing into two branches to go into the kidneys, and uniting again when it comes out, is singular to this bird or is in common with geese and other water-fowl I don't yet know; but so it was in this ostrich. I will suppose it to be in common, till I have examined further, since I know that the cæcums of the ostrich, which are so much taken notice of, are no more than what it has in common with other fowls; and that a chicken has two as large and as long in proportion as the ostrich. The omentum upon the stomachs and guts was six inches thick at the top, and decreasing gradually

dually, was near two inches thick at the vent, and was divided into two parts in the middle from the top to the bottom. What I was sure was in common with other fowls I have not taken much notice of, unless represented by others differently from what I found, or so as if peculiar to this bird. I forgot to take notice that the basis of the os hyoides is of this figure  and the round part at the top is lodged in a proper cavity in the top of the tongue. Partly under the basis of the os hyoides lies a cartilage in the front and very beginning of the aspera arteria, which is not unlike the thyroides; but other cartilages in that part it has none, except what forms the rimula. The first twenty eight cartilages of the aspera arteria are not annular, the rest being about two hundred and twenty six are entirely annular; but as soon as it divaricates to go into the lungs, they are not so.

XIX. **T**HE river Mene that divides Anglesey from Carnarvonshire near which I live, has at present the bottom of its channel for some miles in length all bedded with good oysters, in such plenty that in the season several boats are daily employed to dredge them up, and have been so these eight or nine years last past to their great profit. What I think observable is, that about twenty four years ago, we are well assured there were none to be found on that bottom. But a gentleman about that time caused three or four hundred large oysters to be dropped into the channel just under his land; the spat or seed of which being probably dispersed by the flux and reflux of tides and received by small stones and a large cultch, the whole bottom at length became covered with oysters. And what favours this conjecture is, that at the first finding they appeared young and small, but have since yearly increased in bulk and plenty, though prodigious quantities have been taken up of them.

Of stocking the river Mene with oysters. By the Rev. Mr. Rowlands. n. 369. p. 250. Sep. &c. 1721.

XX. **T**WO short miles from my house we have a fine pond of half a mile over, that has little or no communication with the sea. An ingenious man, about threescore years ago, for an experiment took a pail of large smelts from the river and put them into this pond, where they have increased abundantly, but are degenerated to a very small sort; for our river-smelts I suppose are full as large as those of the Thames, some of them I know will weigh two ounces and a half, whereas these small ones will not weigh five penny weight. We reckon the pond-smelt eats much better than the other: they are very transparent and of a beautiful shining pearl-colour.

Smelts degenerated in New England. By Paul Dudley Esq; n. 374. p. 231. Nov. &c. 1722.

XXI. **M**R. Borassau a native of Canada confirms father Hennepin's and Mr. Kellug's account of the large trouts found in the lakes of that country, and solemnly affirmed there was one taken lately that weighed eighty six pounds: which I am the rather inclined to believe upon the general rule that fish are according to their wa-

Large fish in the river Niagara in Canada. By the same. n. 371. p. 71. Ap. &c. 1722.

ters. To confirm which, a very worthy minister now alive in N. England affirmed to me, that while he was a prisoner at Mon-real in Canada river he saw a pike brought up one day from the river to the governor's house, carried upon a pole between two men, that measured five foot and ten inches long and was proportionably large.

*An herma-
phrodite lob-
ster dissected.
By Dr. F. Ni-
cholls n. 413.
p. 290. Mar.
1730.*

XXII. **T**HE world has frequently been amused with appearances proper to both the sexes in persons who have from thence termed themselves hermaphrodites. But such of them as have passed a more strict examination, have proved that those appearances were either morbid cases, or præternatural formations of the parts proper only to one sex. Thus an elongated clitoris has passed for a penis, and steatomatous (or other) tumours of the labia pudendi have been thought testicles, while the subjacent vagina has been the only proof of the existence of the parts proper to both sexes in the same subject. So that at present the existence of præternatural hermaphrodites seems universally denied. Nor is it easy to conceive how an hermaphrodite can be formed in a species whereof each sex has the parts subservient to generation single, and necessarily situated in the same parts of the body; at least without either a very remarkable mal-formation of the body in general, or so perverted a situation of those parts, as must very much impair their uses.

But in those animals whose parts of generation are double and independent on each other, as the lobster, crab, and many birds, the parts proper to both sexes may possibly be formed in the same subject without prejudice to their uses. But in that case the several parts can be but single; and consequently the subject so formed cannot be termed perfect as to its species, in regard to either sex, though it may be perfectly of both sexes so far as regards generation.

Under this idea of an hermaphrodite, I may venture to say the lobster referred to my examination is truly one; and if split from head to tail, is female on the right side, and male on the left side.

To illustrate this, I shall give a short account of the structure of the male and female lobster, so far as relates to the difference between the two sexes, and then proceed to shew in what manner they were combined in the subject before you.

It has already been observed that the lobster, both male and female, has all the parts of generation double, except that the female has one passage only, through which it is probable the ova are emitted out of the trunk, in order to be affixed to the small appendages under the tail.

The penis of the male lobster arises from the testicle, and is no more than a continuation of the vas deferens; it is reflected and re-torted once, after which it grows thicker as to its substance (probably forming a corpus cavernosum) and terminates, not in the last leg but one, as Willis in his treatise de animâ brutorum has observed, but

at

at a small perforated tubercle in the first bone of the last leg. A A Fig. 49. the two penes.

Between the two last legs and the two legs above them are two processes, which from their resembling the nymphæ of women I shall term nymphæform processes. These processes are covered with hair, and unite at their bases without leaving any passage. BB the two nymphæform processes.

Below the two last legs towards the tail are two appendages, which from their similitude I shall term the styliform appendages. These in the male are thick, hard, and void of hair. CC the two styliform appendages.

The tail is continued from the trunk in a gradual decrease of its dimension, and is covered by plates which extend themselves but little below the substance of the tail, and terminate in acute angles, without any ways diverging. DD the terminations of the plates.

It is to be observed that sometimes these plates are edged with short and thin hair, and sometimes have no hair.

The female, on the other hand, in the place of the testicle has an ovary, which like the testicle extends itself from the stomach to near one half of the tail. From the middle of the ovary a duct descends to the legs which opens at a round hole edged with hair in the first bone of the last leg but two: this is the uterus. AA the entrance into the two vaginæ.

Fig. 50.

The two processes which I have termed nymphæform, in the female make a more obtuse angle at the union of their bases, are less hairy, and leave a passage through which it is probable the ova are emitted, to be affixed to the appendages under the tail. BB the two nymphæform processes; D the passage for the ova.

The two styliform appendages in the female are soft, thin, and edged with long hair. CC the two styliform appendages.

The plates covering the tail are extended much farther under the tail than in the males, beside which they diverge in order to leave a greater space for containing the ova; for the better defence of which they terminate broad, and are edged with thick and long hair. FF the terminations of the plates covering the tail.

In the hermaphrodite lobster I found all these parts proper to both sexes regularly disposed, but in such manner that the parts proper to the female were to be found only on the right side, and the parts proper to the male only on the left side.

In the antepenultimate leg the os uteri was very obvious on the right side as in the females, but had not the least mark of any such passage in the same leg on the left side. A the os uteri only on the right side.

Fig. 51.

The nymphæform process on the right side made an obtuse angle at its insertion into the body, and was soft and perforated as in the females, while the corresponding process made a less angle, was more hairy

hairy and rigid at its basis as in the male. B the right nymphæform process; C the left process.

The styliform process on the right side was soft, flat, and edged with hair, as in the female; but on the left side it was stiff, hard, and void of hair. D the right styliform process as in the female; E the left styliform process, as in the male.

In the last leg on the left side the perforated tubercle for the passage of the penis as in the male was very conspicuous, but without the least appearance of such tubercle, in the corresponding leg on the right side. H the perforated tubercle for the passage of the penis.

The plates covering the tail were extended on the right side considerably below the substance of the tail, and were edged with thick and long hair, and terminated broad as in females. F the termination of the plates covering the tail.

On the left side these plates were much less extended below the tail; were almost totally void of hair, and terminated in acute angles. G the termination of the plates covering the tail on the left side.

Fig. 52.

These plates diverged likewise on the right side as in the females, but not on the left side as in the males. A the diverging of the plates on the right side; B the plates no ways diverging.

Upon removing part of the great shell, I found the internal parts of generation in both sexes exactly corresponding to those externally described.

In the right side adjacent to the heart, the oviduct was regularly disposed, it was full of ova, and sent off its oviduct or uterus, to the antepenultimate leg. F the ovary; G the oviduct or uterus leading to the antepenultimate leg.

In the left side the testicle was rightly disposed as to its form, substance and situation; part of which I was obliged to remove in order to shew the penis, which terminated as in all males, at the tubercle in the first joint of the last leg. E the penis; I, part of the testicle unremoved.

I had some thoughts of removing so much of the great shell as was necessary to shew the course and terminations of the uterus and penis at their proper orifices. But considering that by that means the tail would too easily separate from the trunk, and the appearances of the other marks be rendered less obvious, I chose only to lay them open at the back, believing that to be sufficiently satisfactory to those who understand the structure of this animal. I have steeped it in three different spirits, and carefully disposed it in a glass which I have stopped in the best manner I can, that it may remain in the repository as an undeniable proof of so remarkable a fact.

*Ambergris
found in whales
By Dr. Boyl-
ston, n. 385.
p. 193. O.A.
Ec. 1724.*

XXIII. 1. **T**HE most learned part of mankind are still at a loss about many things even in medical use; and particularly were so in what is called ambergris, until our whale fishermen

men of Nantucket in N. England three or four years ago made the discovery. Their account is this.

Cutting up a Sperma-Ceti bull whale they found accidentally in him about twenty pound weight of that drug. After which they and other such fishermen became very curious in searching all such whales; and it has been since found in less quantities in several male whales of that kind, and in no other, and that scarcely in one of an hundred of them. They add further, that it is contained in a cyst or bag, without any inlet or outlet to it, and that they have sometimes found the bag empty, and yet entire.

The bag is no where to be found but near the genital parts of the fish. The ambergris is, when first taken out, moist and of an exceeding strong and offensive smell.

XXIII. 2. **T**HE following account respects only such whales as are found on the coast of N. England, and of these there are divers sorts.

An essay on the natural history of whales. By Paul Dudley Esq; n. 387. p. 256. March 3c. 1725. The whale-bone whale.

The right or whalebone whale is a large fish measuring sixty or seventy foot in length, and very bulky, having no scales, but a soft fine smooth skin, no fins, but only one on each side, from five to eight foot long, which they are not observed to use, but only in turning themselves, unless while young, and carried by the dam on the flukes of their tails; when with those fins they clasp about her small, and so hold themselves on. This fish when first brought forth is about twenty foot long, and of little worth, but then the dam is very fat. At a year old, when they are called short-heads, they are very fat and yield to fifty barrels of oil; but by that time the dam is very poor and termed a dry-skin, and won't yield more than thirty barrels of oil, though of large bulk. At two years old they are called stunts, being stunted after weaning, and will then yield generally from twenty four to twenty eight barrels. After this they are termed skull-fish, their age not being known, but only guessed at by the length of the bone in their mouths. The whale-bone, so called, grows in the upper jaw on each side, and is sometimes six or seven foot in length. A good large whale has yielded a thousand weight of bone. 'Tis thought by some that the hairy part of the whale-bone, and which is next to the tongue, serves for a strainer of their food.

The eye of a whale is about the bigness of an ox's eye, and situated in the after-part of the head on each side, and where the whale is broadest; for his head tapers away forward from his eyes, and his body tapers away backward; his eyes are more than half way his depth or nearest his under-part; just under his eyes are his two fins; he carries his tail horizontally, and with that he sculls himself along.

The entrails of this whale are made and situated much like those of an ox, and their scalps are sometimes found covered with thousands of sea-lice. One of these whales has yielded one hundred and thirty

thirty barrels of oil, and near twenty out of the tongue. The whale-bone whale is the most valuable, except the Sperma-Ceti whale.

The scrag whale.

The scrag whale is near a-kin to the fin-back, but instead of a fin upon his back, the ridge of the after-part of his back is scragged with half a dozen knobs or nuckles; he comes nearest the right whale in figure and for quantity of oil; his bone is white but won't split.

The finback whale.

The finback whale is distinguished from the right whale by having a great fin on his back from two foot and an half to four foot long, which gives him the name; he has also two side fins, as the whale-bone whale, but much longer, measuring six or seven foot. This fish is somewhat longer than the other, but not so bulky, much swifter, very furious when struck, and very difficultly held; their oil is not near so much, as that of the right whale, and the bone of little profit, being short and knobby. The belly of this whale is white.

The humpback whale.

The bunch or humpback whale, is distinguished from the right whale by having a bunch standing in the place where the fin does in the finback. This bunch is as big as a man's head, and a foot high, shaped like a plug pointing backwards. The bone of this whale is not worth much, though somewhat better than the finback's. His fins are sometimes eighteen foot long and very white; his oil much as that of the finback. Both the finbacks and humpbacks are shaped in reeves longitudinal from head to tail on their bellies and their sides, as far as their fins, which are about half way up their sides.

The Sperma-Ceti whale.

The Sperma-Ceti whale is much of the same dimension with the other, but of a greyish colour, whereas the others are black; he has a bunch on his back like the humpback, but then he is distinguished by not having any whale-bone in the mouth; instead of which there are rows of fine ivory teeth in each jaw, about five or six inches long. I have sent the society one of these teeth. The man who gave it me says the whale was forty nine foot long, and his head made twelve barrels of Sperma-Ceti oil. They are a more gentle fish than the other whales, and seldom fight with their tails; but when struck usually turn upon their backs and fight with their mouths. The oil which is made of the body of this fish is much clearer and sweeter than that of the other whales.

The Sperma Ceti oil, so called, lies in a great trunk about four or five foot deep, and ten or twelve foot long, near the whole depth, breadth, and length of the head, in the place of the brains, and seems to be the same, disposed in several membranous cells, covered not with a bone, but a thick grizzly substance below the skin, through which they dig a hole and lade out the clear oil. Not but that the head and other glandulous parts of this fish will make the Sperma-Ceti oil; but the best, and that which is prepared by nature, is in the trunk aforesaid: and an ingenious man, who has killed many of these whales, assures me that the trunk alone will afford from ten to twenty barrels. Besides the Sperma-Ceti oil, this fish will yield from twenty to fifty barrels of common oil.

One

One of our country doctors tells me that the tooth of this fish shaved or powdered and infused in liquor, equals the harts-horn, and has been given in the small-pox and to lying-in-women, in case of sickness, with success. The quantity is as much as will lie upon an English shilling.

They generate much like our neat cattle, and therefore they are termed bull, cow, and calf. The Latins called the whale *bellua marina*. They bring forth but one at a time and but every other year. When the cow takes bull she throws herself upon her back, sinking her tail, and so the bull slides up, when he is up she clasps him with her fins. A whale's pizzle is six foot long, and at the root is seven or eight inches diameter, and tapers away till it comes to about an inch diameter: his stones would fill half a barrel, but his genitals are not open or visible like those of the true bull. The calf or young whale has been found perfectly formed in the cow, when not above seventeen inches long, and white; yet when brought forth is usually twenty foot, but of a black colour; it is supposed they go with young about nine or ten months; they are very fat in that time, especially when they bring forth. When the female suckles her young she turns herself almost upon her back upon the rim of the water, she has two teats of six or eight inches long and ten or twelve inches round. The milk is white like that of a cow; and upon opening a young sucking whale the milk was found curdled in his bag, just like that of a calf.

The propagation of whales.

Their care of their young is very remarkable; they not only carry them on their tails and suckle them, but often rise with them for the benefit of the air; and however they are chased or wounded, yet as long as they have sense and perceive life in their young they will never leave them, nor will they then strike with their tail; and if in their running the young one loses his hold and drops off, the dam comes about, and passing underneath takes it on again. And therefore care is taken by those who kill these mate fish (as they are called) only to fasten the calf, but not to kill her till they have first secured the cow. For so soon as ever the calf is dead the cow perceives it, and grows so violent that there is no managing her.

Their care of their young.

The whales are very gregarious, being sometimes found a hundred in a scull, and are great travellers. In the fall of the year the right or whale-bone whales go westward, and in the spring they are headed eastward. But here it must be noted, that the several kinds of whales don't mix with one another but keep by themselves.

Whales are very gregarious.

Their way of breathing is by two spout-holes in the top of the head. The *Sperma-Ceti* has but one, and that on the left side of the head. Once in a quarter of an hour, when not disturbed, they are observed to rise and blow, spouting out water and wind, and to draw in fresh air: but when pursued they will sometimes keep under water half an hour or more; though 'tis observed that when any cow has

Their way of breathing.

her

her calf on her tail she rises much oftener for the young one to breathe, without breathing herself. Out of their breathing holes they spout great quantities of blood, when they have received their death's wound.

Their food.

For the first year they all suck the dam. After they are weaned, the right whales, as is generally supposed, live upon some ouzy matter which they suck up from the bottom of the sea. The triers that open them when dead say they never observed any grass, fish, or any other sort of food in the right or whale-bone whale, but only a greyish soft clay, which the people call bole armoniac; and yet an experienced whale-man tells me, that he has seen this whale in still weather skimming on the surface of the water, to take in a sort of reddish spawn or brett, as some call it, that at some times will lie upon the top of the water for a mile together. Here also it may be observed, that though the body of this whale is so very bulky and so exceeding fat, yet when cut open they are seldom found to have much more draught than that of an ox, and they dung much as neat cattle do. Their swallow is not much bigger than an ox's: but the finback whale has a larger swallow; for he lives upon the smaller fish, as mackarel, herring, &c. great schools of which they run through, and with a short turn cause an eddy or whirlpool, by the force of which the small fish are brought into a cluster; so that this fish with open mouth will take in some hundreds of them at a time. The Sperma-Ceti whale, besides other fish, feeds much upon a small fish that has a bill; our fishermen call them squid fish. The small pieces of these squid bills are plainly to be discerned in the ambergris and may be picked out of it; they appear glazy, and like little pieces of broken shells.

The manner of killing them.

Mr. Harris in his *Bibliotheca navigantium*, &c. has given a very particular account of the method of taking whales at Greenland, and though our way in N. England differs very much from that, yet I shall wave it as not so strictly appertaining to philosophy. Only I would take notice of the boats our whale-men use in going from the shoar after the whale: they are made of cedar clapboards, and so very light that two men can conveniently carry them, and yet they are twenty foot long, and carry six men, viz. the harponeer in the fore-part of the boat, four oar-men, and the steerf-man. These boats run very swift, and by reason of their lightness can be brought on and off, and so kept out of danger. The whale is sometimes killed with a single stroke, and yet at other times she will hold the whale-men in play with their lances near half a day together; and sometimes they will get away after they have been lanced and spouted blood, with irons in them, and drugs fastened to them, which are thick boards about fourteen inches square. Our people formerly used to kill the whale near the shore; but now they go off to sea in sloops and whale-boats, in the months of May, June, and July, between Cape-Cod and Bermudas where they seldom miss of them; they lie by in the night,

night, and sail to and again in the day, and bring home the blubber in their sloops. The true season for taking the right or whale-bone whale is from the beginning of February to the end of May; for the Sperma-Ceti whale, from the beginning of June to the end of August. And it has been observed by our fishermen, that when a Sperma-Ceti whale is struck he usually, if not always, throws the excrements out of the anus.

The wonderful, and even prodigious strength of this creature, lies principally in the tail, which is both their offensive and defensive weapon. Many instances of this kind I have had from credible eye-witnesses; I will mention but a few. A boat has been cut down from top to bottom with the tail of a whale, as if cut with a saw, the clap-boards scarce splintered, though the gunnel upon the top is of rough wood. Another has had the stem or stern-post (into which the ends of the cedar clap-boards are nailed) though about three inches thick, and of the toughest wood that can be found, cut off smooth above the cuddee, without so much as shattering the boat or drawing the nails of the clap-boards. An oar has been cut off with a stroke upwards, and yet not so much as lifted up out of the thole-pin. One person had an oar cut off while in his hand, and yet never felt any jarring. A few years since one of the finback whales came into an harbour near Cape-Cod, and towed away a sloop of near forty tun out of the harbour into the sea. It is thought that the whale rubbing her self upon the fluke of the anchor, or going near the bottom, got the fluke into her nisket, or the orifice of the uterus, and finding herself caught tore away with such violence that she towed the sloop out of the harbour as fast as if she had been under sail with a good gale of wind, to the astonishment of the people on shore, for there was nobody on board. When the whale came into deep water she went under, and had like to have carried the sloop with her, but the cable gave way, and so the boats which were sent out recovered her. The whale was found dead some days after on that shore, with the anchor sticking in her belly.

It has been observed that the same way the head of a whale lies when dead, so it will lie if not forcibly turned; and let the wind blow which way it will, they will scull a head though right in the eye of the wind, and they are much easier towed to the shore, if they die that way with their head, than any other.

The enemies of the whale, or the fish that prey upon the whales and often kill the young ones (for they won't venture upon an old one, unless much wounded) our whale-men name killers. These killers are from twenty to thirty foot long, and have teeth in both jaws that lock one within another. They have a fin near the middle of the back four or five foot long. They go in company by dozens, and will bait a young whale like so many bull-dogs; some will lay hold of his tail to keep him from threshing, while others lay hold of his

Their great strength.

Their enemies.

head, and bite and thresh him, till the poor creature being thus heated lolls out his tongue, and then some of the killers catch hold of his lips and if possible of his tongue; after they have killed him they chiefly feed upon the tongue and head, but when he begins to putrify they leave him. This killer is without doubt the Orca that Dr. Frangius describes in his treatise of animals. His words are these, "Quando orca insequitur balænam, ipsa balæna horribilem edit mugitum, non aliter quam cum taurus mordetur a cane." These killers are of such invincible strength, that when several boats together have been towing a dead whale one of them has come and fastened his teeth in her and carried her away down to the bottom in an instant. Sometimes they have bit out a piece of blubber of about two foot square, which is of that toughness that an iron with little beards being struck into it will hold till it draws the boat under water. The killers are sometimes taken and make good oil, but have no whalebone. The carcases of whales serve for food for gulls and other sea-fowl as well as sharks.

*Ambergris
found in the
Sperma-Ceti
whale.*

• Vol. II. P.
II. C. III. §.
lxix.

I come now to what I first and principally proposed in this essay on the natural history of whales, to give an account of the ambergris. Many and various have been the opinions even of the learned world as to the origin and nature of this precious perfume; some have reckoned it a bitumen, and to issue from the entrails of the earth; others, that it was produced by some insect, as honey, silk, &c. The famous Mr. Boyle, as I find it in Lowthorp's abridgment of the Phil. Transf. *, communicates an account of ambergris from a Dutch merchant, who first denies it to be the scum or excrement of a whale, and then gives it as his opinion that it is a fat gum which issues from the root of a tree, and that you may raise it in quantities by planting those trees by the shore, and so the stream will cast it up to great advantage. But truth is the daughter of time; it is now at length found out that this *occultum naturæ* is an animal production, and bred in the body of the *Sperma-Ceti* whale, analogous to what is found in some land animals, as the musk hog or *taiacu*, the musk deer, the bezoar sheep, and some amphibious animals, as the musquash, &c. who have their valuable scent in a particular cystis or bag. I am apt to think that what first gave occasion to the notion of ambergris being the production of the whale, was its being found in considerable quantities on the shores of the Summer islands, and among the Bahama's, where the dead whales are frequently wreck'd and broke up with the sea, and the ambergris found floating or on the shore; but here again the ingenious, until very lately, were at a loss and divided in opinion, for though they agreed it to come from the whale, yet some took it to be the true and proper semen, being found only in the bull at the root of the penis near the testicles; others again thought it was the ordure or excrement of the whale.

The best and most exact account of ambergris that I have been able to procure (and I have taken a great deal of pains for it) I very lately received from one Mr. Atkins, now an inhabitant at Boston in N. England, who used the whale fishery for ten or twelve years together, and was one of the first that went out a fishing for the Sperma-Ceti whales about the year 1720, and then began to discover the ambergris. As he is a sober ingenious man, what he says may safely be depended on; though for substance I have had it from several of the whale-men. His relation taken a few days since from his own mouth is as follows:

"The ambergris is found only in the Sperma-Ceti whales, and consists of balls or globular bodies of various sizes, from about three inches to twelve inches diameter, and will weigh from a pound and an half to twenty two pounds, lying loose in a large oval bag or bladder of three or four foot long, and two or three foot deep and wide, almost in the form of an ox's bladder, only the ends more acute, or like a blacksmith's long bellows, with a spout running tapering into and through the length of the penis, and a duct or canal opening into the other end of the bag and coming from towards the kidneys; this bag lies just over the testicles which are above a foot long, and is placed lengthways at the root of the penis, about four or five foot below the navel and three or four above the anus. This bag or bladder is almost full of a deep orange coloured liquor, not quite so thick as oil, and smelling strong, or rather stronger of the same scent with the balls of ambergris, which float and swim loose in it; the inside of the bag is very deeply tinged with the same colour as the liquor, which may also be found in the canal of the penis; the balls seem to be pretty hard while the whale is alive, inasmuch as there are many times found upon opening the bag large concave shells of the same substance and consistence that have scaled off from them, and the balls themselves seem to be composed of several distinct coats inclosing one another, something like the coats of an onion.

As to the number of balls, Mr. Atkins never found above four in a bag, and in that where he found one which weighed twenty one pounds, being the largest he ever saw, there was no other.

He further says, "That to one Sperma-Ceti whale that has any of these balls, there are two that have nothing but the deep orange-coloured liquor aforesaid in their bags." This remark confirms what another whale-man told me, "that the ambergris was found only in such Sperma-Ceti whales as are old and well grown." It is the general opinion of the whale-men that the ambergris is produced only by the male or the bull Sperma-Ceti whale. As to this particular Mr. Atkins says, "He never saw nor certainly heard of a Sperma-Ceti female taken in his life, the cows of that species of whales

“being much more timorous than the males, and almost impossible to be come at, unless when haply found asleep on the water, or “detained by their calves.” This is certain, the boats can never come near them when they are awake, they are so very shy and fearful.

Mr. Atkins’s method of getting the ambergris out of the whale is thus; after the fish is killed he turns the belly upwards and fixes a tackle to the penis, then cuts a hole round the root of the penis thro’ the rim of the belly till he comes to the entrails, and then searching for the duct or canal at the further end of the bag, he ties it pretty near to the bag and cuts the duct off beyond it, upon which he draws forth the penis by the tackle and the ambergris bag entirely follows it, and comes clean and whole out of the belly.

One of my intimate acquaintance in a neighbouring town who took the preceding relation from Mr. Atkins apprehends the bag aforesaid to be the urinary bladder, and the ambergris ball to be a certain concretion formed out of the greasy odoriferous substance of the liquor aforesaid contained within it. As for my own part, I dare not pretend to give any opinion upon the point, but content my self with relating matter of fact.

The hirudinella marina or sea leach. By Monsr. Garcin. n. 415. p. 377. Sep. &c. 1730. Fig. 53.

XXIV. **U**Pon opening one of the fish called Bonite I observed a small worm which adhered so strongly to the inner membrane of its stomach, that I could not easily pull it off. Fig 53. represents this little animal in its natural size and dimensions. Its shape nearly resembles that of a leach; the body being round, a little flatted towards the belly B, and all along adorned with many parallel circular furrows. Its colour is greyish, and somewhat transparent, except the belly which looks dark, occasioned by a thick black liquor contained in the bowels, and appearing through the integuments. On its back and underneath two black lines begin by an acute angle near the neck and terminate towards the anus: these are vessels which serve for nutrition, and are seen through the skin.

Its body is divided almost equally into two parts by a little round muscular protuberance C on the under side, which it dilates or contracts at pleasure; when this is in its greatest extension it may be compared to an acorn-cup with its mouth a little drawn together. Under the head E it has a little conical or almost hemispherical pump, with which it sucks its nourishment as other leaches do. By means also of this and the protuberance C it fastens itself to any body, or shifts its place. Before it fastens the protuberance it shortens it by withdrawing its extremities nearer to its center; then applying it to the place, it raises the center a little up towards its body and swells and stretches it every way; so that being almost void of air, and equally pressed on all sides by the external air, it sticks like a cupping glass. The animal thus fixed on its center extends, contracts, or arches its forepart every way as occasion requires, and with its pump sucks the juice of any thing

thing within its reach. When it finds it convenient to remove, it first extends its forepart, and fixes its pump at as great a distance as it can; then relaxing the fibres of its protuberance it drags the hinder part towards the forepart, and fixes the protuberance as before. Thus all its motions are performed by the forepart while the hinder part is wholly unactive.

This insect did not live above two hours after it was taken out of the fish's stomach, which I found quite empty. Being exposed to the air it grew languid, but recovered a little when it was put into the sea water. It became considerably less before it died.

As the Bonite preys upon other fish, it is probable that this leach lives by sucking their blood: but that failing we may suppose it fastens its pump to the membrane of the Bonite's stomach to suck nourishment from thence, and if so, it must give it a very painful sensation of hunger.

XXV. **I**N cutting off several thin slices from a piece of beef, whenever I cut the fleshy fibres transversely I could plainly discover the membrane, as it is commonly called, which runs between and envelopes the fleshy fibres, and especially the larger fasciculi of them as they run lengthwise along the muscle. Between these fasciculi the membrane is of a considerable thickness, but spreads out every way into ramifications exceedingly small. I had observed some weeks before that this membrane was composed of an inconceivable number of very small vessels, which were plainly to be discerned not only where the membrane appeared of some considerable breadth, but even where it was not so broad as a single muscular fibre; but how far this held I could not determine, forasmuch as these small ramifications of the membrane did again spread themselves into other ramifications so exceedingly fine, especially where they enclosed the single muscular fibres, that they were in a manner invisible even through my best microscopes.

The very small vessels which compose this membrane as it is called, are doubtless framed to convey some nutritious juices, yet they are so small that the globules of blood cannot pass through them.

That this might be the better understood I caused a small piece of the membrane to be designed, *A. B. C. D.* which with the adjoining fleshy parts is cut through transversely, and since it was impossible for the designer to draw the extraordinary number of vessels which composed it, on account of their being so exceeding small, he has represented them only by points.

Although in my former letters I gave some draughts of the carnosus fibres cut through cross-way along with the membranes, yet for the satisfaction of such as have not seen those, I have here given another draught of the same, between *E. F. G.* and *H. I.* fig. 54.

Of the membranes enclosing the fasciculi of muscular fibres. By Mr. Ant. Leeuwenhoek n. 367. p. 129. Jan. 1721.

Fig. 54.

These

These carnous fibres when wet lay so close to each other that the space between *E. F. G.* and *H. I.* was quite filled up; but when dried the fibres were so shrunk that one might see such spaces between them as are here delineated.

Now as we see, upon the drying of the membranes *A. F. G.* and *D. E. G.* with the muscular fibres between them, what a number of small ramifications proceed from the membranes, as is here represented between the muscular fibres; we must not imagine that these ramifications proceed only from the points here represented, but that they are continued the whole length of the fibres, and subdividing themselves into still finer ramifications enclose every single fibre in the whole muscle.

Fig. 55.

Amongst several pieces of flesh where the carnous fibres were cut transversely, I happened on one piece with its branches so plain that the membranes and fibres looked like so many boughs of trees with the leaves on them, *K. L. M. N.* where *M.* shews the so called membrane torn off from another, as also how many branches it runs into and the many fibres it covers.

All these carnous fibres with the so called membranes lay very compact together when I cut them off from the piece of flesh, as likewise when I laid them on the glass and moistened them; but as the moisture dried away they shrunk again in the manner here represented, and although the designer could plainly distinguish the small vessels which were cut through, the largest of which appeared at *M.* yet he was obliged to mark them only with points. Here you may observe that all the carnous fibres having been closely tied together by the said membranes wherein they were enveloped, which are nothing but a congeries of vessels, could not be separated from each other upon drying, but by tearing asunder those membranes.

The carnous fibres along with the so called membrane, *K. L. M. N.* do not take up more room than a grain of sand may cover, and yet one might very distinctly observe in some of those carnous fibres the parts of which they were composed.

This observation I was resolved to pursue in the flesh of a whale, of which I had kept two pieces by me for about seven or eight years of about a span long and two inches thick; from these I cut several slices transversely, but found that the carnous fibres so cut through did easily separate from one another. This made me think that the membranes were rotten: therefore I cut off the outside with a table-knife, and then with a very sharp knife I cut the inner part into very fine slices, and there I found the excrements of mites, which were very small but globular, and some of them as small as I had ever seen before; and so going on I found these excrements every where, especially where the membranes were thickest; then looking into such places where the membranes were thinnest, insomuch that I was satisfied a mite just come from the egg could hardly find room there, I discovered

discovered in the so named membranes the aforesaid vessels, and that in as great a number as I had seen them in the ox's flesh, and as plain as one can see the holes in a thimble with the naked eye.

XXVI. 1. **S**ome observations which I made on the fibres of wood + turned my thoughts to the fleshy fibres of animals, considering with my self that since the author of nature usually observes the same frame and structure in a great variety of his creatures, perhaps the fine membranes, with which every muscular fibre is invested and which are provided with an innumerable multitude of small vessels, might carry nourishment through every carnosus fibre in a healthy body, in the same manner as in vegetables.

Of the muscular fibres of different animals. By the same. n. 367. p. 134. Jan. 1721. † Vid. supra P. II. C. V. §. II. 3.

In this view I cut off some very small thin slices from the flesh of an ox, directly across the length of the fibres, and having placed them upon glasses and moistened them with clean rain-water, I observed them with a very good microscope, and continued viewing them so long that the fleshy fibres began to grow dry. I then saw that in some places the exceeding small and fine vessels, which compounded the membranes wherewith the fleshy fibres were enclosed, were broken off from the fleshy fibres by the unequal shrinking of the thin slice of flesh upon the plate of the microscope. I saw at the same time some other of these small vessels which were something stronger than the former and were not broken off from the fleshy fibres, but yet were stretched and drawn from them to the distance of the diameter of a blood-globule*. I saw likewise some fleshy fibres which adhered so close to other fibres that the small vessels of communication were not broken off or stretched, so that nothing was to be seen there but only the membrane encompassing the fibres.

* Vid. infra §. xxviii.

I likewise placed before the same microscope several other carnosus fibres which I had separated according to their length from the flesh of an ox. In each of these I observed a great number of extremely small apertures, by which I judged that the small vessels of the membranes had entered the fibres; which vessels having been moistened with water, as soon as the little moisture which had been left in those apertures was evaporated I could see them very plain and distinct.

Now since two persons of note have lately maintained that the blood circulated through the carnosus fibres, in order to examine into the truth of this hypothesis, I pricked my thumb with a fine needle and placed a little blood upon the glass where the carnosus fibres lay, with design to observe with my microscope what was the proportion between the diameters of a globule of blood and of the aforesaid apertures in a fibre.

While I was employed in these observations in came the painter who for these many years has drawn all my discoveries, and not being willing to trust too much to my own eyes, he being much younger and better sighted than I, I placed before him the small apertures in

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the fibres, which he said were plain enough to be seen, and when he had viewed them to his satisfaction I placed before him likewise the globules of blood which lay together in great numbers, and yet so distinct and separate one from another as one shall seldom see them. I then asked him what he thought to be the proportion between the diameter of a globule of blood and the diameter of one of those apertures in a fleshy fibre. After a little pause he gave me for answer, that the diameter of a blood-globule was four times as large as the diameter of one of those apertures. If so, then according to the known rule, a globule of blood must be divided into sixty four parts before it can enter through one of these apertures into a fleshy fibre.

This discovery appeared to me very wonderful, and I am apt to think that it will be very difficult to penetrate any deeper into the hidden structure of the muscular fibres, and the manner by which they receive their nourishment.

Having committed these things to paper my thoughts ran again upon the muscular fibres; and considering what I had said formerly concerning them, that they were composed of long, small filaments, I was not satisfied therewith, and therefore endeavoured to discover whether these small filaments which compose a carnosus fibre might not really be so many small vessels. With this design I took part of the flesh of a whale which I had kept some years by me, and cut it into very thin slices directly across the fibres, which having moistened with fair water I placed them upon several glasses and before several microscopes, when I observed that what I had formerly taken for small threads or filaments were in reality exceeding small vessels. I then cut part of the whale's flesh lengthwise, in order to discover the vessels which convey the nutritious juice out of the membranes into the muscular fibres, which vessels then appeared to me in great plenty and very distinct.

I afterwards took another piece of the flesh of a very fat ox which I cut through transversely, and looking upon it with some of my best microscopes, I could plainly see that how small soever these fibres were they were still vascular, for I could see the light through the apertures of these vessels as I had done before in those of a whale; but if I happened to cut the fibres never so little obliquely instead of cutting them directly across their length, the light was not to be seen through them.

The hind quarter of a mouse had lain by me for some years; from the largest muscle of it I cut off transversely some small slices as thin as possibly I could. Then placing them before my microscope, I not only saw that the carnosus fibres were of the same thickness with those of an ox, but besides I could see the apertures of the vessels composing the carnosus fibres as plainly as in the flesh of a whale. The vessels in the muscular fibres of a whale are indeed six times more in
number

number than in those of an ox or a mouse, but then the fibre of a whale is also six times as thick as the other.

Hereupon I considered after what manner the vessels of which the muscular fibres mostly consist received their nourishment from the vessels of the membranes; since the muscular fibres, when they are at rest, have many alternate corrugations, by which I judged that the vessels in the fibres must have their sides pressed together and their cavities closed up. But if we call to mind that in walking a man may move both his feet above 3600 times in an hour, (for he may make two steps in the time of one pulsation of the artery,) and that in that space of time the muscular fibres must be so many times extended and contracted, and will therefore require great supplies; we shall likewise find that this is sufficiently provided for, since upon every extension of the muscle the apertures of those small vessels are free and open for the carriage of nourishment into the fibres. This wonderful structure of the membranes and the vast number of vessels they consist of, as likewise the small vessels of which the muscular fibres are composed, has never yet to my knowledge entered into the thoughts of any man, and with many will hardly find credit.

XXVI. 2. **I**T has been affirmed to me by several persons, and *Continued by the same, n. 368. p. 190. May &c. 1721.* in particular, by a learned foreigner, that nature in all her various productions constantly observes the same course and manner of operation. To this assertion my observations by no means agree; neither those that I have made upon the generation of animals, and the seeds of plants; nor yet those that I have made upon the muscles and muscular fibres of different animals; forasmuch as the muscles of fishes are not provided with any tendons. On this occasion, I have lately examined anew the muscles of the cod-fish, upon which I have made the following observations.

After the late discoveries I had made of the small vessels in the muscular fibres of the whale, the ox, the sheep, and the mouse, I was apt to imagine that the same fabric would hold in the muscular fibres of fish likewise: but as this could not be certainly concluded, I cut a piece of cod into small slices, some according to the length of the fibres, and others directly across them, in order to observe whether these muscular fibres were composed of great numbers of small vessels running according to the length of the fibre. And in effect I found, that when I had cut the fibres dexterously through, there appeared in the microscope as great a number of small vessels running along these fibres, as I had formerly seen in the muscular fibres of a whale.

But what appeared to me most remarkable was, that in a great number of fibres, in which I was not able to discover any vessels running according to their length, I observed abundance of small vessels, which seemed to me to proceed from the membranes encompassing the fibres. For in one fibre these vessels appeared to come out of the cir-

circumference or circular tunicle of the fibre, and to pass on to the opposite part of the tunicle. And in another fibre cut transversly I saw vessels arising from the circumference, and dividing themselves into smaller branches about the middle of the fibre; all which, as far as I could perceive, ended again in the circumference of the fibre. In one fibre I saw at least fifty of these vessels running through one another.

Upon this discovery I found I had been mistaken in what I had at first imagined, which was, that the vessels which arise from the membranes proceed no farther than just through the tunicle of the fibre, and so discharge the fluid into the fibre for its nourishment. Whereas now I perceived that the vessels which arose from the membrane and entered into the fibre did not end there, but spread themselves into smaller branches proceeding every way from the inside to the tunicle of the fibre. This caused me to think that the nutritious juice might circulate in these small vessels, just as the blood does in the veins and arteries; and that what the muscular fibres received from them might be no more than what oozed through the tunicles of these small vessels, as I have said of the small vessels in land-animals, which have no other end than the artery coming from the heart and the vein terminating in the heart; the artery and vein thus making one continued vessel.

Having now a great number of fibres lying before me, in which I could see very plainly the vessels just now treated of, yet I could not discern in the transverse sections of the fibres any appearance of those vessels which run along their length, and compose the greatest part of the body of each fibre. This I imputed to the cutting of those vessels not directly across but something obliquely, by which their apertures had been closed in such a manner that I could not perceive them nor the least resemblance of them.

I have several times observed between the muscular fibres of fish a great number of vessels lying together, which composed what is commonly called a membrane; which vessels surrounded the muscular fibres, and lay so many of them together that the thickness of the whole fasciculus of vessels was equal to that of a muscular fibre, and, as I imagined, was afterwards to be dispersed in smaller ramifications between the fibres.

In taking a view of an entire muscle of a cod-fish and the fibres of which it was composed, I found the thick end of the muscle to equal the back of an ordinary knife, and the thinner end not to exceed the thickness of a single fibre. Many of these fibres are twice as long as the thickness of the muscle, and between the muscles lie what are commonly called membranes, which are nothing else but a congeries of vessels. These vessels do not only run between the fibres, but into the very substance of every fibre, as we see when the fibres are cut transversly. By these vessels the muscular fibres and the entire muscles

muscles themselves are so firmly bound together, that they serve instead of tendons to one another.

In like manner the muscular fibres are united to the bones by the vessels proceeding from the bones, which vessels compose what in land-animals is called the periosteum.

In order to give a clear notion of what I mean when I speak of the muscles of a cod-fish, I have caused two of those muscles to be delineated lying close together as they are united to one another, and separated from the other muscles, *A, B, C, D*, the part designed by *Fig. 56.* *A, B, C*, having been covered with the skin near the head of the fish. And it is my opinion that the body of the cod-fish, from head to tail, consists of a continued series of such muscles.

I have likewise caused a single muscle of the fish to be represented by *E, F, G, H*, where *E, H, G*, shews the thickness of the muscle; *Fig. 57.* and its thin edge, which is no thicker than the edge of a knife, is marked by *E, F, G*.

Though these muscles had lain several days upon a paper they were not dried so hard but that I could split them into thin shivers, one of which is designed between the letters *I* and *K*, in order to shew the *Fig. 58.* oblique course of the fibres, which are represented by small lines.

I now turned my thoughts to the river-fish, and particularly to the perch; and, as I imagined that an old perch had no greater number of muscular fibres than a young one, but only that the fibres encreased in bigness during the growth of the fish, and that the larger these fibres were, the more plain and distinct must be the small vessels of which the fibres were composed; I sent orders, upon a market-day, to bring me the largest perch that was to be found in the market; and accordingly I had one brought me the largest that I had ever seen, weighing three pounds and an half, and seventeen inches and an half in length Delft measure, which is the same with the Rhinland.

I cut off four pieces from this fish, as two from the back near the head, and two others from the belly in the thick part of the fish, with design to make my observations upon them the next day.

Accordingly, at that time, I took a view of the muscular fibres both in length and breadth, and found that the fibres of this great perch were not so thick as those of the cod-fish. Upon cutting them through lengthwise, I saw the apertures of the small vessels in so great a number, as I could hardly have believed if I had not seen them. I next cut some of the fibres transversely, and plainly found them thinner in this perch than in a middling cod-fish, and saw the small vessels that compose the greatest part of the bulk of the fibre, lying as close together as ever I saw them in any kind of fish or flesh.

To give a better notion of these muscular fibres and of the great number of small vessels of which they are chiefly composed; I had some weeks before placed some of them cut transversely in pieces be-

Fig. 59.

fore a microscope, with design to have them drawn by my painter, but had been obliged to defer it by the great severity of the weather. These had been a little moistened before they were placed upon the glass, in order to make them stick to it the better; and I have caused a small portion of these muscular fibres of the fish, cut thro' transversely after they were grown dry and in their shrinking had been torn off from the small vessels that encompass'd them, to be represented, as at *L, M, N, O*. The openings of the small vessels in these fibres were distinctly to be seen, but appeared in such great numbers, and were so exceedingly small, that it was impossible for the painter to represent them any otherwise than by points.

In this figure are represented what we call the membranes, but which indeed are nothing else but a congeries of small vessels, which not only surround the fibres, but enter into their very substance. These, in the drying and shrinking of the object upon the plate, had been torn off from the fibres, as may be seen at *P, P, P*.

Fig. 60.

When this was done I put a small drop of water, about the size of a pin's head, on this small portion of fibres, into which it immediately insinuated and swelled them to the same bigness, as when they were first laid upon the plate: after which I desired the painter to draw them as they then appeared to him, but to omit representing the small vessels, and only to design the circumference of every fibre, which he did, as appears at *Q, R, S, T*.

Fig. 61.

I then clove a grain of millet through the middle, and placing one half of it upon the glass beside the portion of fibres represented in fig. 59. I desired the painter to observe the difference in bigness between the half grain of millet-seed and that portion of fibres; who told me that the half grain appeared larger than the portion of fibres, and so said likewise a second person that viewed them. By which one may easily imagine in how small a space that number of fibres is comprehended, each of which consists of so many vessels. I caused the painter to represent the half grain of millet at fig. 61.

I likewise made my observations upon the muscular fibres of a pike, a roach, schar, and flounder, in each of which I found the fibres to be composed of small vessels, like those of a cod and perch.

I had now a mind to examine the muscular fibres of the smelt, to see whether they were likewise composed of vessels, but not being able at that time to meet with any, it came into my head to observe the same in dried sprats. Accordingly I took the largest of these I could light on, which was a little more than five inches in length, and I found that the fibres of the sprat were but little thinner than those of the large perch spoken of before, and that the vessels of which the fibres were composed were nearly as numerous as in the fibres of the perch.

From these observations some persons may be apt to conclude that the muscular fibres of land-animals are of the same thickness with

those of fish. But for the satisfaction of those who have not seen the objects here spoken of, I have caused a small portion of the muscular fibres of a large ox to be delineated, as they appeared through the same microscope with the former, to shew the thickness of the dried fibres and the vessels that compose them, *X Y Z.*

Fig. 62.

I desired the painter to tell me, how many vessels he could see in the transverse section of one of these fibres; who after some pause replied, that he counted five and twenty vessels in one fibre.

Some time after this I had a small smelt brought me, of the length of about two joints of my finger; and cutting some of its muscular fibres transversely I placed them before a microscope, and saw not only that these fibres were twice as thick as those of an ox, but likewise that they were provided with as great a number of vessels as the fibres of other fish.

Upon thus observing that the muscular fibres of fishes were much larger than those of beasts, I set my self to consider for what reasons the great Creator of the universe had made this disproportion between them. All the satisfaction I could meet with in my thoughts upon this subject was that, as the fish swim in the water their muscular fibres need exert very little force to support their bodies in the water, because they are very nearly of the same specific gravity with the element in which they swim. All the force they exert is in their progressive motion in pursuit of their food. Whereas the muscular fibres of land-animals exercise a great force, not only in supporting and moving their own bodies, but in carrying burthens and other labour they are put to. And we must allow, that the smaller and finer the fibres are to make a body of any determinate thickness, the stronger will be the composition, and therefore the muscles in flesh must be stronger than those of fish. But this I leave to better judgments.

It justly claims our admiration to see the wonderful and amazing structure of these minute parts in the muscles of beasts and fish, which never entered into our thoughts; and no doubt there are many other surprising things there inclosed, which will perhaps for ever escape our penetration.

XXVI. 3. **A**BOUT eight days ago I viewed a portion of the flesh of a fat ox, as likewise the muscular fibres of a cod-fish and of a perch; which fibres being cut transversely, I could see in them very distinctly the great number of small vessels that ran along the length of each fibre. And I saw the same this month of April in the muscular fibres taken from the hinder leg of a mouse and cut through transversely.

Continued by the same, n. 371. p. 72. Ap. Et. 1722.

In speaking formerly of the small fibrillæ that help to suspend the testicles of a ram, I forgot to mention that each of these consists of exceeding small vessels which run parallel to its length.

I have

I have at this time standing before a microscope a small portion of the bone of an ox, in which may evidently be seen the vessels which proceed from the bone and compose what is called the periosteum, as likewise the openings of these vessels. The reason of their appearing so clearly is, as I imagine, that they are filled with the medullary oil.

Of the particles of fat. By the same. n. 367. p. 132. Jan. &c. 1721.

XXVII. 1. **A**fter the discoveries that I had formerly made concerning the circulation of the blood, particularly that the blood-vessels had no endings, I began to consider how the fat particles could be formed, since I did not think that they were separated from the blood and came out of the blood-vessels. But having now plainly discovered that the so called membranes were nothing but very small vessels, and believing that they were created for no other end but to transport nutriment, as also that there was no circulation in these vessels, I imagined that the matter which we call fat was brought into them, which, when there was too great a supply of nutriment so that it could not be forced farther on, must be driven out of these vessels; for all the particles of fat that I have as yet observed are inclosed in small films.

This original of the fat is to me much more credible than that it should be forced out of the blood-vessels; though I cannot as yet determine how these fat particles, which consist of small globules and those of still smaller globules (as it appears to me) are made and formed: as also where these vessels which constitute what we call membranes have their beginning, and how this fat is brought into them.

Examining a piece of ox's flesh that I believe had lain by me about four years wrapped up in a paper, I found in it some places covered with a membrane; from this I cut off several small slices along with the membrane, and I found that near the membrane there lay about sixteen or eighteen nervous fibrils, which in the drying of the flesh were so squeez'd together, that they were almost twice as long as they were broad. In some of them I saw very distinctly those vessels which are in the nerves.

These nervous fibrillæ were enclosed by a sort of half round separating them from the muscular fibres, which half round consisted of a row of small tendinous fibrillæ, each of which was about twice as thick as a hair of a man's beard. Without these tendinous fibrillæ lay the muscular fibres that had been cut through transversely, and in this part of the half round there were several apertures, which seemed in the microscope big enough for hemp-seed to pass through, which might well be taken for vessels but that there lay so many of them together. But considering that the nerves are commonly covered with fat particles, I concluded that these apertures were no vessels, but meer particles of fat, which I found to be true when I had cut through them and discovered that the inward fat was eaten out by the mites which

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had left only the husks or cortices of the fat globules behind : which cortices I never had hitherto been able to discover, because the cortices of the fat globules would upon any heat melt away as fast as the inward fat.

XXVII. 2. **I** Have formerly said † that the matter which we call meal or flower in wheat, rye, barley, oats, and in all sorts of beans, is shut up as it were in little cells or chambers, and that those little cells are separated from each other by thin membranes, which are thinnest in wheat. And as in the enquiry into what is called the periosteum of an ox or sheep I have often broke in pieces the fat particles thereof, and as often viewed through a microscope the said broken particles, so have I likewise placed a few of the fat globules upon a clean glass plate and held it over a coal fire or the flame of a candle till they were all melted ; so that not only the fat, which was shut up in the skin of the fat globules, but likewise the skin itself was reduced to a fluid matter. In this state I immediately brought it before my sight, and viewing it with attention perceived, when the melted fat was cold that there were different matters inclosed in the said fat globules ; for there appeared an inconceivable great number of exceeding small coagulated particles, and the rest of the parts of which the fat was composed lay in one smooth and even substance ; and I have been considering whether there might not be inclosed in such a globule of fat so many little cells and partitions as we see in a little grain or seed, but if it be so it will remain concealed from our eyes.

*Continued by
the same. n.
372. p. 93.
June 1722.
† Vid. supra
P. II. C. V.
§. II. 5.*

Having now again carefully contemplated these coagulated globules of fat many of which go to the making of one little bubble, I often fancied that I saw in each of the said small particles such a transparent dent as I have before said the meal globules of wheat, &c. have ; and considering that the great Creator of the universe has made all his creatures almost after the same manner, and that there grows no plant whatever but its seed, though never so small, has inclosed in it the same sort of particles as are found in bigger seeds ; and that though they differ in magnitude, yet are they analogous one to the other ; this being so, I say, we may easily imagine that as a fat globule has a bark or skin as well as any seed, they are furnished within with particles analogous to those of the seeds which we call wheat, oats, and the like ; and although we render the fat fluid by the help of fire, yet will the small particles which are inclosed in the fat globules again resume their former figure.

Yea I have fancied to myself, though it did not appear to my sight, that each fat particle is furnished with little cells within like the seeds or fruits of plants.

After I had written this I was informed that my butcher had killed a sheep of an uncommon bigness, weighing a hundred and forty pounds

pounds without the fat that they took out of it after it was killed, which weighed fifty one pounds, so that the whole sheep weighed above 190 pounds.

I ordered a piece of the fat that grew about the kidneys of the said sheep to be brought to me, imagining that its fat particles would be of a coarser grain than those of ordinary sheep; for I have observed several times that the bigger an ox was the larger were the fat particles thereof; and since not one man in a thousand has any knowledge of the contexture of these fat particles, (for we find that there are not any two of one and the same figure, they being compressed by other particles with which they are surrounded) I have caused some few of these fat particles to be drawn, as between A, B, C, D.

Fig. 63.

Now when we meet with one of these little bundles of fat particles, as has frequently occurred to us, in which the fat particles were four times this thickness; I imagine that such fat particles cannot be produced out of one single adipose vessel, but that out of such a vessel several small sprigs issue forth, and out of each of those small sprigs proceed others still smaller, and that out of these particles one larger fat particle is formed like a bunch of grapes.

I cut off with a razor the fat in several places of a greater piece as thin as I could, laying the thin slices upon several glass plates over a coal-fire; as soon as they melted, I immediately viewed them with a magnifying-glass, when I observed the skins or membranous coats of the fat globules lying among the melted particles, and in the said melted particles there was nothing to be perceived but a limpid matter surrounded with small air-bubbles; but when the fat was congealed, we could observe but very little of the membranes, because they were covered with the particles of fat with which these membranes or skins had before been filled.

Fig. 64.

I caused a few of these skins of the fat globules to be drawn, as in fig. 64. between E, F, G, H. During the said observation I fixed my eye with attention upon the fat particles of the sheep which had been melted and were again coagulated; and I could not but judge that these fat particles which were exceeding small, were analogous to that internal matter wherewith some of the smallest little seeds are furnished; and in a great many of these exceeding small particles I could in clear weather discover some transparency.

Moreover, I cut as thin slices as it was possible of the fat, yea so thin that five or six of them did not weigh a grain, and put them into a little water, in order to try whether I could make any farther discoveries thereby with respect to the small particles of fat; but it was in vain: only I saw floating upon the water very small particles of fat which were coagulated in a spherical figure, the very biggest of them being no bigger than a grain of sand. I placed these particles upon a glass plate; and viewing them with a microscope I observed

served the figure which I mentioned above as plain as before; and other fat particles seemed to be of a different figure. I put one of these into the hands of my painter or designer, bidding him to draw what he observed, it being the figure of one of the said fat particles which was coagulated on the water, represented by fig. 65. between I, K, L, M, which was not very conformable with the other melted fat particles; for in the doing it all the particles did not melt, for the fat particles are not all extracted by the water, and coagulate upon the water in smaller and greater globular particles; and when we take out of it the remainder of the thin slices of fat which float upon the water and view them with a microscope, we find that many of the fat particles appear intire to the eye; and whereas they were before very smooth and even in their sides, they were now changed into rough and uneven particles; so that one would be apt to think there were two different sorts of particles in the fat, and that one sort melted more easily than the other.

Fig. 65.

Now in order to get these melted particles of fat out of the water without altering them, I made use of a round glass wherewith I skimmed the superficies of the water; by which means some of the coagulated particles stuck to the glass. Moreover, I again melted some of the fat particles, which had been coagulated upon the water, over a coal fire as they lay in the water; and when they were again coagulated, viewing them with a microscope I found the small fat particles to be yet smaller than those that were melted out of the water.

In this last observation I perceived with astonishment the inconceivable number of veins and membranes which were diffus'd through the fat, and the multitude of separated fat particles that were involved in their several membranes.

After this there was laid before me the hind-quarter of a sucking lamb, over which was spread what we call the net or caul; and having cut off some pieces of the said net or caul, upon which there was little or no fat, with a pair of scissars, and placing them before a microscope, I observed again that the fat particles where there were very few of them included between the membranes, were of a more globular figure than in other parts where a good many lay together, and that in other places they were pressed or bruised, which I fancy was occasioned by the butcher's squeezing the caul in that place with his fingers; and in another place the fat particles had been so torn in pieces that I could see nothing remaining but the skins of the fat globules.

Moreover, I saw that the fat particles had such a pinch or dent in them, as I have shewn to be in the globules of flower of wheat; whereby I am confirmed more than before in my opinion, that the fat globules might be separated intirely or in part from the skin with which they are surrounded, by opening the dents without breaking the skin.

Then I took off the thin membranes which encompassed the fat particles, and viewing them with a microscope observed that the fat particles had imprinted a roundish figure on the membranes inclining to a hexangular shape, that it was a pleasure to look on them; but in other parts they were of an oval figure.

Moreover, I took a flat fish which we call plaife and taking off the fat which adhered to the vessels or bones I viewed it with a microscope and observed that the fat particles were of several sizes; and some were so small that I judged that fifty of the least were no bigger than one great fat globule; moreover, I saw that many of the fat globules had such a pinch in them as we find in the meal or flower of those little white beans which we call French or kidney-beans.

Afterwards my servant brought me the fat of a perch nine or ten inches long, and taking a little of it I viewed it with a microscope, but could not discover any small particles in it nor any internal dent as I had observed in the fat of a small plaife.

After the fat of the perch had lain an hour or two upon the glass I viewed it again, and observed that the particles were lessened or become smaller, and that the skin of the fat particles, which as yet was beset with some fat particles, was as it were shrunk or wrinkled, and the fat that was burst out lay about the fat particles, and was so fluid and transparent that we could not discover any parts in it.

From this observation I began to think whether each of these fat particles was not provided with an orifice or hole out of which the fat might be protruded at all times, as often as the parts of the fish stood in need of nourishment, without an entire laying open the skin of the fat globules; for we constantly find that when the eggs of the perch, which we call the roe, increase in bigness, its fat decreases; yea in such a manner, that when the said eggs or roe are arrived at their utmost bigness, there is seldom or never any fat to be seen upon the intestines of the fish.

The diameters of the globules of blood. By the same to Dr. Jurin. n. 377. p. 341. May &c. 1723.

XXVIII. 1. **E**X tuis litteris intellexi inventam tibi rationem esse, qua diametros globulorum sanguineorum aliarumque minutissimarum rerum certo cognoscere possis, adeo quidem utprehenderis diametrum globuli sanguinei cum parte $\frac{1}{1940}$ lati pollicis magnitudine convenire.

Hoc ego inventum cum legerem summa voluptate affectus sum; statimque sic mecum ratiocinabar; si 1940 globulorum sanguineorum diametri lato pollicis longitudine respondent; adhæc si corpora instar globi rotunda eam ad invicem proportionem habent quam habet numerus cubicus ad suum axem, sicut a geometris traditur; sequitur corpus quod ex 7301384000 globulorum conjunctione componitur haud

haud majus esse corpore globoso cujus axis latum pollicem longitudine adæquet.

Et quia de examinando denuo sanguine me rogaveras ; meum ipsius & duorum præterea hominum sanguinem visu exploravi ; planeque comperi 4 diametros globulorum sanguineorum, uti scripsisti, convenire cum diametro ⁿ fili argentei quod mihi mittere dignatus es. Id solum dicere habeo, quod globulos quosdam sanguineos, sed perpaucos, visu perceperim ; quorum quaternæ diametri diametrum fili argentei longitudine aliquatenus excedebant. Verum conjiciebam globulos illos, quos ex pollice per acus punctiōnem eduxeram & adhuc calentes vitro imponebam, a rotunditate figuræ nonnihil descivisse ad figuram planam.

XXVIII. 2. **D**icis hanc explorationem non esse indifferentem seu inutilem, quoniam non impossibile est quin illa observatio de globulorum sanguineorum magnitudine in variis animalibus, una cum suis parvulis vasculis, ductura sit nos aliquando ad detectionem ubi & quibus mediis hi globuli formentur, & inde determinatam crassitudinem in eodem animali conservent.

Of the globules in blood and in the lees of wine. By the same to Dr. Jurin. n. 380. p. 436. November &c. 1723.

At mihi quidem videtur nos nunquam ad explorationem illam perventuros, quomodo scilicet hi globuli ex materia fluida ad magnitudinis determinatæ globulos sint coagulati.

Multis abhinc annis ad me asportari jussi vinum fermentans, quia hoc vinum globulos producit fere sanguineis æquales, quos vini fœces vocamus : & quamvis tale vinum microscopio apponerem, tamen nil aliud videbam quam innumerabilem multitudinem parvissimorum globulorum aëreorum sursum ad superficiem vini adscendentium, & secum illos globulos quos vini fœces nominamus ducentium. Cum jam in superficiem vini venerant, separabantur vini fœces a globulis aëris & fundum repetebant, nec percipere poteram quomodo globuli quos dicimus vini fœces formabantur : simulac, ni fallit memoria, globuli illi inferius descendissent, exhibat ex globulo quoque iterum globulus aëreus, & ita denuo ad superficiem vini devehebatur.

Imaginer mihi coagulationem illam ac determinatam globulorum sanguineorum magnitudinem à rerum primordiis esse creatas ; nam si unus globulus altero major esset, suspicamur exinde inordinatam circulationem fore secuturam, quoniam sanguinem per varia vascula sanguinea rapidè transluentem vidi, quæ adeo exilia erant ut simplex saltem globulus transire potuerit.

ⁿ Hujus fili argentei diametri 485 pollicem, sive duodecimam pedis Londinensis partem, conficiebant ; quod compertum fuerat per methodum in Actis Philosoph. expositam N° 355. pag. 761.

† Vol. IV.
P. I. C. V.
§. iv. p. 344

An account of a Book omitted.

n. 365. p. 83. XXIX. **C**Onghietture del Dottor Pietre Anton. Michelotti Filosofo & Medico d'Arco, sopra la natura, cagione & rimedi dell' infermita regnanti ne' animali Bovini di molte città &c. nell' autunno del' anno cadente 1711 in Venezia 1712.

CHAP. II.

The General AFFECTIONS of the HUMAN BODY.

The anatomy of a decrepit old man. By Dr. J. James Scheuchzer. n. 376. p. 313. March &c. 1723.

I. **S**UOS habent characteres varii ætatis gradus. A fluiditate ascendit homo sensim per soliditatis varias mutationes, donec cum rigiditate & fibrarum veluti immobilitate amittat vitam. Nec contemnendi est usus hæc in medicinâ consideratio.

Accidit ante menses aliquot, ut ob decrepitam suam ætatem & raram, in nosocomium fuerit receptus J. Leon, Vopper, Rhoetus, Sharanienfis ex cœtu Glantino fœderis superioris. Is juxta tenorem testimoniorum lucem primum vidit, 1 Majj 1614. A. 1634. Metallî fossor in venâ sepultus, per horas 33. sub terrâ jacuit: mortuo, quam vivo similior inde protractus, propter abdominis validam quam passus est pressiõnem, inde ab illo tempore incontinentiâ urinæ laboraverat. A. 1637. iter fecerat per Hungariam, Turciam, Terram Sanctam, reversus Venetias. Post A. 1639. militem egit in servitiis Caroli Ducis Lotharingiæ, in statu Mediolanensi, & A. 1663. in Lusitaniâ. A. 1682. interfuit obsidioni Viennensi, & in ultimo bello obsidioni Landaviæ & cladi Hockstettenfi. Ita vitam, per varios casus & mille rerum discrimina, protraxit senex noster ad annos 109. menses 3. obiit autem die 2 Feb. 1723.

In cadavere observavimus, cursoriè veluti, (non enim licuit per temporis angustiam sectioni diu immorari) sequentia.

In abdominis cavo erat, parvâ quidem copiâ, serum sanguinolentum extravasatum.

Intestina tenuia fuere omnia inflammata, rubro colore tincta, & duodenum præ primis integrum admodum dilatatum, internâ sui parte fracidum prorsus & gangrænosum; omentum prorsus emaciatum, ut vix agnosci potuerit: pancreas contractum: hepar sanum: vesicula fellis bile repleta: ductus choledochi eâdem turgidi, & tota vicinia intestinorum & mesenterii virore infecta, ut alicubi extravasata videretur bilis, cujus egressum in duodenum invenire haud potuimus. Prope pylorum, in ventriculi superiore parte, aderat expansio veluti flatulenta, nuce juglande major. Renes sani, ut & lien, cujus exterior membrana, jucundo admodum spectaculo, obsessa erat hinc inde maculis

maculis nivei candoris, magis minusque latis, quæ primo intuitu referebant pustulas variolarum maturas, sed cartilagineæ prorsus erant duritiei, & ultra superficiem reliquæ membranæ aliquantum elevatae. Observo heic, antequam progrediar ulterius, non duntaxat rigescere fibras, & contrahi supremâ ætate, sed tantum non insensiles fieri; nemo quippe juvenilis vel consistentis ætatis pateretur inflammationem intestinorum, qualis hæc fuit, absque acutissimo dolore, de quo tamen æger post senile delirium, quod aliquamdiu est perpeffus, ad se ultimis vitæ diebus rediens, nihil est conquestus. Cartilaginea illa lienis crusta manifesto est indicio, posse ita rigescere membranas, ut tandem indurentur.

Thoracis apertio non parum faceffebat laboris. Fuerunt quippe non solum sterni illæ costosæ prominentiæ, aliàs cartilagineæ, heic planè ossæ, sed & cum ipsis costis tantum non continuæ, indicio manifesto cartilagineas fieri successu temporis ossæ, quemadmodum membranæ & arteriæ fiunt cartilagineæ, & ex cartilagineis non semel ossæ narrant historiæ. Pulmones viridantibus passim maculis obsessi, in utroque thoracis latere, posticâ sui parte affixi erant costis: pericardium amplum & multo sero refertum, cujus & aliqua portio in cavo fluitabat thorace. Cor ipsum vidimus satis amplum, imprimis aurículas dilatatas præter modum, & tum hæc tum ventriculos sanguine concreto refertos, unde patet substituisse tandem sanguinis motum, propter defectum contractionis elasticæ in tubulis arteriosis, & cordis machinam sanguini ad concretionem disposito expellendo non amplius fuisse sufficientem, imo propter nimiam resistantiam obrutam. Præstabat tendinem illum, quo cordi inferuntur arteriæ, vel osseum plane, vel cartilagineum saltem: osseus sane, quod novimus, fit in cervis adultioribus, unde os de corde cervi. Et sanè aliquid tale offendimus, nimirum valvulas semilunares, præprimis aortæ, cartilagineas penè, præcipuè mediâ sui parte. Aortam ipsam descendentem observavimus valdè amplam, diametri duplo majoris, quam est gula, Parisini circiter pollicis. Gulæ instratæ passim erant glandulæ lentiformes induratæ. Amplitudo illa aortæ indicat tardio rem ultimis fortè vitæ annis progressivum motum sanguinis, unde arteriæ quæ propiores sunt cordi fuere sensim dilatatæ, sicuti sæpe observamus dilatari adeo, ubi nimia est molis resistentia, ut in aneurisma abeat egrediens è corde arteria magna.

Pergimus ad caput, ubi prædura cranii substantia rursus solitò majorem poscebat laborem: suturæ, imprimis sagittalis & lambdoidea, erant fermè oblitteratæ, nec prorsus penetrabant utramque tabulam, ut nulla fuerit per illas è cavitate illâ magnâ capitis perspiratio, & succus ille ossium nutritius, inter fissuras suturarum extravasatus, factus quoque fuerit osseus. Foramina quidem tria quatuorve satis ampla, in supremo vertice, ad latus utrumque sinus sagittalis, pollicis fermè distantia ab invicem visuntur, internam laminam ad externam usque penetrantia, nec tamen ullum illorum utramque perforat tabulam.

lam. Dura meninx triplo ferè crassior fuit quam est ordinariè, coriacea penè: pia separabatur facile, nimio utpotè irrigata sero, à cerebri substantiâ: ventriculi omnes sero erant referti, quod sat magnâ copiâ quoque fluitabat in cerebri basi, imprimis ad spinalis medullæ egressum. Plexus choroides glandulis pisalibus, lymphâ coagulata refertis, erat obsessus: septum pellucidum egregiè poterat conspici: cæterum cerebri ipsa substantia, imprimis interioris, flaccidior solito.

Innotuit mihi inde ex quo obiit decrepitus noster, retulisse eum quibusdam fide dignis, quod pater ejus, sæculum jam supergressus, tres genuerit liberos, & ex majoribus pauci infra sæculi ætatem obierint. Hoc certum est, nostro natam filiam Mariam Magdalenam quæ S. Baptismatis caractere signata fuit 18 Aug. 1707.

Of the use of the bile in the animal oeconomy. By Dr. Alex. Stuart, n. 414. p. 341. May &c. 1730

II. **M**R. Menzies being in the 40th year of his age was wounded in the gall-bladder about three in the morning Oct. 30. 1728.

I was called Nov. 2. about eleven in the forenoon, being the fourth day after he received the wound.

1. The surgeons who had attended him from the beginning told me that his belly had been all along distended as I saw it, giving the appearance of a tympany or ascites, and it continued at the same pitch of distension, neither diminished, nor sensibly encreased, to the time of his death. 2. No ructus or flatus, upwards or downwards, nor borborygmi, notwithstanding this distension of the belly. 3. He never went once to stool after he received the wound, though pretty strong purgatives and several clysters had been given for the three days before I came; and though no opiat (which might have been supposed to have retarded their operation) had hitherto been exhibited: neither had those purgatives nor clysters, which I ordered afterwards, the least effect. 4. He took what was thought a sufficient quantity of drink and liquid food. 5. He never slept, or but very little and very rarely, and that by short slumbers of about half an hour or an hour at longest, notwithstanding pretty large doses of opiats were given after I came. 6. The wound in the integuments never digested in the usual manner; but looked flaccid, or flabby and pale, almost without pus. 7. The urine in very small quantity, at most two or three spoonfuls at a time, clear but yellow, as if tinged slightly with saffron, and without sediment. 8. His pulse was full, strong and even, but not quick. 9. No feverish heat to be felt in the skin or any part of the body. 10. His tongue not hard, rough or black, as in a fever, but of its natural colour, with a silky drinels, and very little saliva. 11. He was not in the least delirious, from the beginning to the time of his death. 12. He had some slight fits of the hickup the second day after I saw him, and some few retchings to vomit; some intermissions in his pulse, sometimes one in 10, 15, 20, or 30 a day before his death.

I. Upon

1. Upon opening the body before several surgeons the abdomen appeared distended as in a tympany or ascites, and the skin of the belly tinged yellow as saffron in many places. 2. A triangular wound appeared about two inches on the right side of the navel, the direction slanting upwards obliquely thro' the integuments. 3. The belly being opened, discovered the wound to have penetrated through the peritonæum, and the sword had slanted upwards from thence along the omentum, which was superficially ruffled, but so as to be hardly perceivable. 4. A small triangular wound appeared in the bottom of the gall-bladder, which had penetrated through the membranes into its cavity, but had no where wounded the liver, nor any of the neighbouring parts. 5. The gall-bladder was flaccid or collapsed, containing only a few drops of gall, which, by pressing the cystis slightly, flowed out into the cavity of the abdomen through the wound. 6. The guts throughout their whole tract being distended, so as could be judged to triple the extent of their natural diameters, seemed to fill the whole cavity of the abdomen, and made the outward appearance of a tympany or ascites; which distension disappeared and the guts collapsed upon making several punctures with a lancet in their sides to give vent to the air. 7. The rest of the cavity of the abdomen which was not closely filled up by the distended guts, contained a gross muddy water or serum, intensely yellow, or highly tinged with gall, to the quantity of three quarts, as I was able to guess without measuring it. 8. All the guts and contents of the abdomen were highly tinged with this yellow liquor, but no other part of his body, out of the contact of this liquor, had the least appearance of it. 9. No inflammation appeared in any part of the guts, or in any of the viscera, or contents of the abdomen, which were all sound and healthy. 10. The obliquity of the wound through the integuments, muscles and peritonæum, made it impossible for the external air to enter into the cavity of the abdomen that way.

In order to make some use of this case, it must be observed, that the great apparatus in the liver and spleen, two of the largest viscera in the body, confessedly designed for the secretion of the bile; and the place of the intestines, into which it is immediately deposited, afford indeed a strong argument for the universal use of it in the animal œconomy; but do not directly point out what, or how many these uses are, about which there has been a great variety of opinions.

But this singular case which must have happened very rarely, if ever before (wherein none of the inwards or viscera, but the gall-bladder only was wounded, and by that wound nothing but the gall was lost) by shewing how many functions in the animal œconomy were impaired or destroyed by the sole loss of it, does at the same time demonstrate the necessity of it towards health; from this loss of the gall, all the symptoms and appearances may justly be concluded to arise, and I think may be accounted for in the following manner.

1. The abdomen was all along distended, as in a tympany or ascites, and the guts appeared inflated to their utmost diameters.

This inflation and distension happens to most a few hours before death, and to all soon after it, and ariseth from the spring of the included air getting the better of the spring of the muscular fibres of the stomach and guts, which have no longer the assistance of the blood and spirits to contract them, and keep up the peristaltic motion. But the distension here spoken of was several days before death, and, as I have been told, the very next day after he received the wound, though the pulse was apparently strong and equal, and therefore a defect of blood and spirits not to be suspected: wherefore it may be justly concluded, that the influx of the gall into the cavity of the guts, is as necessary to the strength of their contraction and perfection of their peristaltic motion, as that of the blood and spirits into their sides; and that these three are the conjunct causes of this motion in health, which would be defective by the total want of any of them.

Hence we see that in scyrrhosities of the liver, where the secretion, and therefore the excretion of the bile is more or less defective; and in the jaundice, where, by some obstruction in the biliary ducts after secretion, a part of it is forced back and regurgitates into the blood, and very little of it is thrown into the guts: I say, in those cases we observe an uncommon distension in the guts, and costiveness; which, if the case proves incurable, terminates in an ascites or dropfy in the cavity of the belly.

It may also be worth while to enquire, whether that which is commonly called an hystERIC or nervous cholic, generally attended with a lesser degree of such like distensions, with flatus's and borborygmi; I say, whether this distemper, wherein the animal spirits are so much, and only accused, does not partly arise from a sluggish secretion and excretion of the bile, occasioning a defect in its quantity; or from its acrimony and great viscosity, occasioned by its stagnation in the gall-bladder; or from both these, as well as from a defective or unequal distribution of the blood and spirits in the parts affected. In confirmation of which I have generally observed, that at some time or other in the cure, a great evacuation of porraceous viscid bile, brought away either by art or nature, as well as a great profusion of pale urine finished the cure for that time. The vomiting of porraceous bile, very common in such cases, proves the same; and, I believe, it is generally allowed that the ferruginous, porraceous and black colour of the bile is owing to shorter or longer stagnations of it, chiefly in the gall-bladder, which the sedentary life of those who are subject to these cholics, will sufficiently account for, even if there was no other error in their way of living; and whoever has observed the high yellow colour and contents of the urine in a jaundice, arising from a redundancy of bile in the blood, will readily acknowledge that

that an uncommon watry paleness in the urine, where no more than the usual quantity of fluids has been taken down to dilute it, does shew a defect of bile in the blood; and I believe it is easy to account for the flatus's, borborygmi, inversions of the peristaltic motion, the pila hysterica, palpitations, scotomia, vertigo, and other symptoms of these distempers which are called nervous and hysteric, from the same cause. And hence it is that bitters and steel, known deobstruents of the liver and correctors of the bile, with gentle cholagogues in very small doses, are of so much use in such cases; though it be certainly true, that all strong stimulating purgatives are very hurtful and improper.

2. There were no ructus's or flatus's nor borborygmi, notwithstanding this distension of the belly and inflation of the guts.

This, I think, shews very plainly that the guts had lost all motion, and were paralytic from a total want of bile only, as much as if their nerves had been entirely obstructed; for had any motion remained in them, whether the natural and regular peristaltic motion, or a preternatural convulsive one, the contraction of them either way would have propelled the contained air from one place to another, and would have occasioned borborygmi, or would have expelled a part of it upwards or downwards, when nature had so much need of it to relieve the distended guts, and art had contributed to that intention by clysters and purgatives given. This serves to illustrate what has been said above concerning the defective and convulsive motion of the guts in hysteric cases, where, through a defect in the quantity or quality of the bile, or from both the motion of the guts becomes defective, irregular or convulsive, but is not totally lost through an entire want of it, as in this case.

3. He never went to stool after he received the wound; and the strongest purgatives and clysters that could be reasonably given had no effect.

This seems also owing to the total loss of the peristaltic motion; and plainly shews that the strongest purging stimulus has not the power to restore it, without the assistance of the gall: for had it been in any degree restored the belly would have fallen proportionally, and some evacuation of what was lodged in the primæ viæ would have followed. If then the power of purgatives depends upon the co-operation of the bile, it will follow that where it is most active or redundant, their operation will be, cæteris paribus, greatest; and where it is unactive or deficient in quantity, they will have proportionally a less effect. Though it be true that a great quantity, or morbid acrimony of the bile, by a too strong and violent irritation, will bring the intestines into such spasms, as to stop all excretion by stool; and the strongest purging stimulus added to it does only encrease the spasms and co-tiveness; as in bilious cholics, which are always attended with exceed-

ing costiveness, not conquerable by the strongest purgatives, if they be not joined with opiats to allay the spasms and obtund the acrimony of the bile.

He took what was thought a sufficient quantity of liquid food and drink; but if the elater of the guts, and their peristaltic motion were lost, it is easy to prove that none of his food or drink could enter the lacteals, and therefore that he died starved.

All that have seen live dissections must have observed that the guts have an alternate contraction and dilatation called the peristaltic motion, the superior section contracting itself, while the immediate inferior is dilated; and this motion is carried on in several parts of the guts at the same time; and the contracting part, by expelling the blood and chyle out of its sides, in its contraction looks pale, while the parts dilated look florid, and the vessels full of blood and chyle. Now the part contracting must necessarily force the chyle from the grosser parts of the food or aliments, towards the inner surface of the guts, where the capillary extremities of the lacteals are ready to absorb it as far as the larger and visible branches of the lacteals on the coats of the guts, into which it easily flows in the time of dilatation, which expands and unfolds these vessels for its easy reception; from which it is farther propelled by the next contraction, into the first order of the lacteals in the mesentery; and by the same repeated impulses of the contracting sections of the guts, is forced farther through the second order of lacteals into the receptaculum commune and the thoracic duct; assisted by valves and promoted by the incessant motion of the muscles and of all the contents of the abdomen and thorax in respiration, it is at last poured into the subclavian vein, for a perpetual recruit of the blood. But if the muscular fibres of the guts have lost their peristaltic motion, then the expression, absorption and progress of the chyle cannot succeed, the blood must be deprived of its recruit and the person die starved, which seems to have been this patient's case, and will sufficiently account for the symptoms above recited.

First, His want of sleep, and the inability of opium to procure it: we see that those who live sparingly sleep very little, and those who feed plentifully require by so much a greater number of hours to sleep; and in all chronical cases, where the body ceaseth to be nourished, sleep also fails and opiats have but little power; whereas in children, a great part of whose food goes towards both nourishment and accretion, the greater part of their time is spent in sleep.

It may indeed seem difficult to conceive how a want of rest should ensue so soon after the accident. But considering that the loss of one meal in a day, especially of supper to such as have been accustomed to it, has occasioned fewer hours rest in the following night, it will follow that such persons require at least some small recruit once in six or seven hours, in order to rest their usual time; and therefore in our case,

case, where all recruit must have ceased soon after the accident, he might be sensible of the impairment of rest in six or seven hours after it, and those about him might well observe the encrease of that symptom, at least in the following night.

Another difficulty ariseth from the observation of swallows and tortoises, &c. who sleep most in winter, when they eat and drink nothing. In answer to which, there seems to be no parity between the natural constitution of their blood and humours, and that of men: to these and such like animals, with regard to recruit and nourishment, action and rest, the spring and summer are as one day, and the winter as one night; and their blood and humours seem to be fitted by nature, not only to bear, but even to require such long periods of rest and action. And probably there is as little parity between the crasis and constitution of the blood and humours of a healthy person, and of those in soporous and cataleptic diseases, who are reported to have slept for weeks or months without food of any kind: and therefore where the crasis and consistence of the blood and spirits are nearly the same, that is, *cæteris paribus*, he who feeds and is nourished most will sleep longest, &c. *e contra*.

The position here advanced is farther confirmed by the inefficacy of the opiats given, they being capable of entering into the blood through the pores of the stomach in contact with them; by which quick passage they have been observed to procure rest soon after they have been applied outwardly, or taken down into the stomach, as in this case, they may justly be supposed to have done: though, for the reasons abovementioned, neither they nor any thing else could pass by the lacteals: but as the aliments could not pass that way, viz. by the pores of the stomach, nor by the lacteals into the blood, there could be no recruit nor nourishment: and therefore the opiats, though they did enter into the blood by the pores of the stomach in contact with them, could not procure rest. Thus it would seem probable that opiats do produce their effect by detaining the chyle crude longer than usual in the mass of blood, and thereby lengthening sleep beyond the usual time; and that they are ineffectual where there is no chyle in the blood to be detained. Their power of retarding or suppressing all or most of the secretions and excretions; their palling or obtunding the appetite; their enabling one to fast long, and supporting one in journies and labour for a long time without food (effects well known to the Turks and Asiatics in their journies through deserts, &c.) these and some other known effects of opium, very much favour this opinion.

Secondly, The want of pus in the wound was probably owing to a want of recruit of chyle in the blood; and the flabbiness and paleness of its lips, to a shrinking of the parts for want of daily nourishment.

Thirdly, The small quantity of urine was also probably owing to a want of recruit of fluids from the *primæ viæ*: for these, in a healthy

healthy state, find their way to the urinary passages very soon. The slight tincture of yellow which it had must have been from the bile spilt in the abdomen, and filtrated through the duplicature of the peritonæum, and bottom of the bladder: for it could not be supposed to derive its colour from the blood, into which no bile could now enter by the common way.

Fourthly, The want of saliva and the silky driness of the tongue seem owing to the same cause, a want of recruit of fluids in the blood, and a loss of so much of them as fell into the abdomen.

Fifthly, If it be supposed that such a small wound through the integuments and muscles of the abdomen and the peritonæum was capable of producing a fever, then his not having any symptoms of a fever must be owing to a total defect of bile and chyle in the blood, none of which could enter the lacteals for want of the peristaltic motion.

Lastly, The few fits of hickup, retchings to vomit, and intermissions in the pulse in declining and dying persons, seem to arise not only from a defect, and therefore an unequal distribution of the blood and spirits, but chiefly from the corruption and irritating acrimony of them, as the immediate cause of death in this and most other cases.

Object. 1. It may very reasonably be objected that the ductus hepaticus would carry a sufficiency of bile for the uses of the animal oeconomy into the cavity of the intestines, though none came by the ductus cysticus; and nature seems to have provided the ductus hepaticus for this purpose, that if any obstruction or defect should happen in any of these secretory channels, the secretion and excretion might still go on in the other. But the effect will not be the same in a wound, which is the reverse of an obstruction; because by a perpetual evacuation through it, such a derivation is made as drains all the neighbouring parts, and either lessens or entirely frustrates the secretion and excretion by them: and this we find to be true where the secretory organs and ducts concerned in the different secretions lie at a great distance from one another; as in the diabetes we generally see a very great desiccation of the salival glands, a defect of saliva, and a perpetual thirst; and sweating and looseness lessen the secretion by urine; an issue drains and emaciates the neighbouring parts; and it is mechanically demonstrated by Bellini, that the flux of blood and of all the humours will be most and strongest towards the part where the resistance is taken off; as in bleeding, to which this perpetual flux of bile through the wounded gall-bladder seems to have a great affinity; and therefore would probably promote the afflux of blood and secretion of the bile so much and so strongly towards the vessels, glands, and secretory ducts leading to the cystis, as very much to lessen, or totally to hinder the secretion by the ductus hepaticus into the guts.

Object.

Object. 2. Another objection is, that as the guts and other contents and even the muscles and integuments of the lower belly were highly tinged by the bile, it is probable that some of it got into the cavity of the guts, where it might by its stimulus keep up the peristaltic motion, and by the lacteals get into the blood, seeing some of it got into the bladder in that manner and tinged the urine.

It is not unlikely that this might happen when the bile came to be very redundant in the cavity; but in passing through the interstices of the vessels and fibres of the guts, as through a filtre, the grosser, saline and sulphureous particles of it, which are the most pungent and active parts, must have been left behind; which the muddy thickness, as well as deepness of the colour of the liquor found in the cavity of the abdomen, compared with the transparent clearness of the urine of a much lighter yellow colour, without sediment, seems to prove: and it is not likely that such a small quantity of filtrated bile, as may be supposed to have passed that way, deprived of all its active particles, could either in quantity or quality be sufficient to the animal oeconomy; and, in fact, if any passed that way, it appeared plainly insufficient to promote the contraction and peristaltic motion of the guts, which remained preternaturally distended from first to last.

Object. 3. It has been also objected, that an animal which dies starved dies delirious and feverish, the experiment having been made on cats and dogs: and therefore this person, who had no fever, nor delirium of any kind, cannot be supposed to have died starved.

I will not dispute these facts, though I have not made any experiments my self, nor do I remember to have had any accurate account of the symptoms of such as have died of hunger and thirst in sieges, and at sea; but no notice, that I know of, has ever been taken of their having died mad, delirious or feverish, though these symptoms are so remarkable and affecting. However, these cases will differ very much from this before us: for an animal starved to death purely for want of food, has the gall flowing continually into the cavity of the intestines, unmixed and undiluted with chyle, and from thence by the lacteals into the blood; so that in a few days this acrimonious juice must become more redundant there than any other humour; which joined with the constant attrition of the globules in circulation, must soon render the blood very acrimonious, rancid and alcalin; that is, must reduce the whole to a mass of putrefaction, capable of stimulating the brain and nerves so as to produce a fever, delirium or madness: but here no gall could enter into the blood: and therefore the same effects in an equal degree could not happen; though it must be owned that, through a want of recruit and dilution, a lower degree of putrefaction of the blood and humours must have followed, even in this case, from the continual attrition in circulation; such at least as was sufficient to render the whole mass in a few days unfit for any
of

of the functions of life, and therefore may be justly supposed to have been the immediate cause of death. For all the passive principles of putrefaction, being actually in the substance of the blood, and all the active principles of heat and attrition being at work upon it to produce this effect, it could not fail to be brought about in a few days; and the same would happen to all animals, if what is effete, corrupted or altered, so as to be unfit for the use of the animal, was not continually carried off by the emunctories, and a fresh recruit daily supplied from the *primæ viæ*; which evacuations and supply being kept up in their due proportions effectually prevent all putrefaction and acrimony, and keep the blood and humours in their natural temperature.

It is not then a defect in the quantity of fluids which kills an animal in fasting, but a poisonous acrimony, which the blood and humours naturally contract for want of a fresh recruit and equal evacuation. Thus in chronical distempers, where the person appears attenuated and exhausted, the quantity of the fluids is certainly very small, yet enough to maintain life for some months or years, being kept in some degree of sweetness or proper temperature by a certain proportion of recruit and evacuation: but where the recruit is entirely subtracted, the evacuations will be proportionally lessened; and therefore the quantity of fluids may remain much the same, but the quality will alter, and putrefaction for the reasons above assigned must take place, and be the immediate cause of death, even long before the mass of fluids can be much diminished in quantity, as in the case before us. Which leads to the answer of another difficulty, viz.

Object. 4. How could the pulse continue full, strong and equal for several days, while the person was in a starving condition, and the blood had no recruit from the *primæ viæ*?

This indeed would be very unaccountable, if the waste of the blood and humours were supposed to continue at the same height as before the accident, and the evacuations by the emunctories were the same as in perfect health. In this manner the contents of the blood-vessels would be soon wasted and exhausted. But Sanctorius's experiments shew, that the daily recruits and evacuations keep pace with one another, and are nearly equal in twenty four hours in a healthy state: and therefore where the recruits are plentiful, the evacuations will be equally so; and where those are sparing the evacuations are small; or where the balance is cast too much of either side, some indisposition or distemper must follow. There is no exception from this rule, but in children, a part of whose nourishment goes to accretion. Now in the case before us, the recruit being entirely subtracted, the evacuations must have been little, or next to nothing: and therefore the quantity of the blood and circulating humours would remain much the same, and keep up the fulness, strength and equality of the pulse

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pulse for several days, until the critical putrefaction and colliquation of the blood abovementioned, on the fifth or sixth day, rendered it unfit for a regular circulation, and produced intermissions in the pulse, retchings to vomit, and hickup, all of them being local convulsions, and the effects of corruption, acrimony, irritation, and an unequal distribution of the fluids, which terminated in death in the beginning of the seventh day.

The sum of what has been said is, that in this case, very little, if any, bile entered into the intestines, and that ineffectual; and none at all into the blood. And as there was no apparent defect in any part of the body, nor any wound that could have been either dangerous or deadly, but as it gave occasion to the loss and misplacing of the gall; it is therefore evident, that all the symptoms, and his death, were entirely owing to the loss of this useful juice; which it seems is so necessary to all parts of the animal oeconomy, natural, vital and animal, that this person could not live above six days without it.

The practical inferences that seem to flow by necessary consequences from this observation, are,

1. That the peristaltic motion of the intestines is as much owing to the influx of the bile into their cavity, as to the influx of the animal spirits and blood into their sides: and therefore that the bile is to be looked upon as one of the prime movers in the animal oeconomy, by which the elastic springs of the natural motions, to wit, the muscular fibres of the guts are set to work; upon whose motion all the subsequent vital and animal motions do so far depend, that none of them can be long in perfection where it is imperfect, nor subsist many days where it is totally wanting.

2. This prime motion is totally lost by a total want of bile; proves sluggish by a defect in its quantity; becomes irregular or convulsive by a great redundancy or morbid acrimony of it. From whence several distempers that are called nervous may arise, and are more likely to be cured by correcting and evacuating the redundant or faulty bile, and disobstructing the liver, than by most other medicines taken from the common class of nervines.

3. That the power of purgatives depends upon the co-operation of the bile: and therefore it is probable, that the difference of constitutions, at equal ages, with respect to purgatives, depends more upon the quantity and quality of the bile, than on the bulk or weight of the body, quantity of the blood, or other circulating humours.

4. It also appears that the nourishment and accretion of the body do in some measure depend upon a due quantity and proper quality of this juice, without which the blood and circulating humours could not be recruited from the primæ viæ: and therefore that defects in it may be frequently the cause of a marasmus, or waste of the body, where it is little suspected: which may serve to point out the method of cure in such cases.

5. This

5. This observation seems to lead to the knowledge of the immediate cause of natural rest or sleep in a healthy state; to wit, a certain quantity or proportion of fresh chyle in the blood; the want of which, from whatever cause, will occasion watchfulness, or some degree of it. And this may serve to point out the immediate effect and consequences of opiats, whence may be gathered how far, and in what cases they may be effectual and useful; and in what circumstances they may be ineffectual, useless or hurtful.

6. That a due quantity of aliments, at proper intervals of time, is necessary to keep the blood and humours in their natural temperature and sweetness, and to preserve them from acrimony and putrefaction: and this will be true in all distempers as well as in health, and is against the practice of such as pretend to starve away distempers, or to deny a due quantity of drink and liquid food to the sick, especially in fevers, where the want of this recruit will tend to increase the acrimony or putrefaction, whence the malignity of most fevers arises.

7. That pus, or matter in a wound or ulcer is the product of chyle, and not of the blood or serum: which has indeed been the received opinion, though supported by no other proof than the similitude of pus to chyle. And as a great redundancy, as well as a defect of pus, does sometimes retard the cure of a wound or ulcer, this may serve to shew by what means it may be increased or diminished, to answer the intentions of the artist.

8. This also makes it appear probable, that a great redundancy of chyle disposeth the body to purulent, suppuratory and scrophulous distempers; and seems to indicate the subtracting such sorts of food as afford a rich, gross or plentiful chyle, and the administering of such medicines as may strengthen sanguification, and the other assimilating powers, to assimilate and thereby consume it; the sanguification and assimilating powers being manifestly weak, as the chylication seems to be strong in all such cases. And this seems to be the reason why in adults, as the sanguification grows stronger, and in age, as the voraciousness of the appetite, too common in youth, declines, these distempers do often decrease, and at last wear out of themselves: which shews what ought to be done to bring about the same effect in a less time.

I must here own my omission through hurry to open the stomach and guts, in order to view the state of their contents, where the gall was entirely wanting, which might have given some light to this observation. But I am apt to believe, that as most of his aliments were liquids, the alterations would not have been very conspicuous.

Spittle of an unusual colour.
By Dr. Huxham to Dr. Jurin. n. 382.
p. 63. March
Æc. 1724.

III. **D**. Fox, quadragenarius, gracilis, biliosus, per mensem unum alterumve elanguerat, nausea, ictero & doloribus colicis vexatus: tandem ex epoto largiter vino pomaceo vehementissimo colices paroxysmo correptus me consulit. Vomitabat omnia, urinae parum

parum reddebat coloris lixivii, quæ sedimenti plurimum deponebat subviridis.

Ego statim illi potionem ex Ipecac. emeticam propinari jubeo, infuso dein C. Bened. affatim hausto plurima viscosa, biliosa, rejecit: tum enemate Terebinth. injecto alvus bis terve respondit. Ex sumpta mistura anodyna vomitus & tormina comprimuntur; jam de languore summo & abdominis distentione conquestio; paulo etiam post recrudescit dolor. Bolum præscripsi ex Jalap. ℥j. Calomelan. gr. viii. Spec. Diamb. gr. vi. Laud. solid. gr. i. Syrup. de Sp. Cerv. q. f. quam primum sumend. cum Tinct. sac. ℥ij. Hinc omnia pacata. post horas 12 ter fundit alvus perliquida, biliosa. Ex sumpto dein haustu anodyno nox tranquilla. Mane de dolore & faucium tumore queribundus crassa, subfusca, expuebat; mox abunde affluit saliva colore viridissima, bili porraceæ quam simillima, nisi quod tenuior. Perduravit fluxus hic salivæ viridis horas quasi 40, quo tempore sputavit quantum vix caperent sextarii duo: ad flavedinem dein vergebat color fluoris eo usque dum ad instar solutionis Gut. Gambæ evasit: quantitas autem aucta potius quam diminuta.

Perstitit & hicce color per horas etiam quadraginta, dein sensim pellucida facta est saliva, atque subito, uti oborta est, evanuit penitus salivatio.

Intra biennii spatium bis terve in icterum inciderat ante hujus morbi accessionem. Decem abhinc annis maxima salivatio sponte erumpens hunc ipsum hominem in summum vitæ discrimen intulerat; salvus autem evasit ope doctissimi expertissimique medici, D. D. Pyne Tunc vero temporis ne vel ̄ii hilum sumpserat, nec ullo modo fuerat colorata saliva.

In hac historia observatu haud indigna quædam occurrunt. Salivatio nempe spontanea, vel ex tantillo forsan Calomel. excitata. Calomel autem probe paratum novi, quippe qui plurimas ejusdemet doses, quarum aliquas ad scrupul. integrum, exhiberi jusseram, ne vel minimo sequente salivationis signo.

Occurrit porro, quantum ego saltem scio, salivæ inauditus color. Saliva viridi ita penitus tincti erant dentes & fauces quasi ærugine obducti fuissent: permansit dentium color viridis quatuordecim post diebus quam convaluit.

Notandum præterea fluxum hunc salivæ fuisse criticum, quo judicatus est & icterus & colicus morbus; ab inceptante enim salivatione ne vel minimus dolor ventris, & color cutis subviridis sensim evanuit, urinam etiam reddidit copiosius; sed subnigram. Ille vero, qui ante hunc fluxum valde languidus fuit & jam quasi moribundus maximam salivæ evacuationem ἐυφρέως φέρεσθαι.

Serum ictericorum tinctum esse bile omnibus notum est: nec alicui forsitan videatur magis mirandum serum flavum posse per glandulas salivares excerni quam per serosa cutis vascula, quod tamen ictero laborantibus contigisse sæpius observavimus, admoto prius epispastico:

de urina biliosa nil dicam. Unde vero color salivæ viridis haud ita facile dictu. Hujus opinor ego causam procatartica esse pomacei vini potationem.

Bili si miscueris acidum color oritur viridis. Hinc torminosæ infantum dejectiones virides, lacte in ventriculo acescente. Hinc porracea bilis. Ponamus jam acidum pomaceum a venis lacteis vel & a mesaraicis forsan, absorptum, seroque sanguinis bilioso permixtum: quid eveniret inde? Credo equidem flavi feri coloris in viridem permutatio. Profiteor hercle, acida quæcumque a vi corporis vitali in alcalinam naturam mutari, etiam ipsum vitrioli acidum: languescentibus autem viribus, concoctione læsa, lymphæ effœta facta, facta & inerte bile, queis adde sanguinem tardius circulantem, acida parum subacta, nec in primis viis, nec in ipso sanguine, acidam exuunt naturam. Hoc testantur acidi debiliū sudores, acidusque in ore sapor a febribus inflammatoriis convalescentium, quibus ad restinguendam febrem largius fuerat exhibitus acidus potus. Sæpius certe memini me vinum pomaceum largiter potasse brevique urinam ipsissimum potus odorem spirantem reddidisse. Curabam nuperrime mulierem summa hæmorrhagia durante diu correptam, cui inter cætera plurimum fuerat exhibitum elix. vitriol. Mynsich. cessavit tandem hæmorrhagia, debilis autem inde reddita mulier incidit in leves spasmos, artuumque dolores, ventris tormina diarrhœa comitante, plures excrevit alvus dejectiones viridissimas, stercoris vaccini simillimas, talesque per plures dies, quanquam rhabarb. fuerat ter exhibitum ad expurgandas acidi particulas, intestinis adhærentes. Hic sal acidus sanguini immixtus post dies plures iterum è sanguine per intestina rejectus est, vi vitæ nullo fere modo subactus.

Microscopio olim observavit Leeuwenhoekius quod chyli sales acidi a bile retundantur & comminuantur; quum vero in jecore subsistat obstructa bilis integris viribus vasa lactea permeat acidum. In ægroto autem nostro bilem obstructam fuisse patuit inde, quod alvus fuerat compressior & fœces ante vomitum medicamento commotum reddidit albidas.

Hypothesis fortasse nostra illustretur magis si perpendamus unde oriatur virginum *καχελών* color herbeus. His enim fructus immaturi, acetum atque id genus alia, summæ sunt cupediæ, vitiatis autem concoctionis organis parum immutata sanguini miscentur, bilemque & sanguinem obruunt acido. Hinc glandulæ obstructæ, hinc facies ex viridi pallida, tumor hinc hydropicus; atque quod non levis est momenti, jecur schirrosus ex chlorosi præmortuarum sæpe inventum fuit viride. Jam paucis restat dicendum unde colori salivæ viridi succedit color flavus, quod inde factum arbitror quia post acidum a sanguine partim ablegatum, partim & a motu sanguinis, ob cardiaca exhibita, aucto destructum, superfuit solum superflua bilis sanguine expellenda, quæ & brevi secessit, reſeratis poris & per patulos salivæ ductus mirandum in modum excreta.

IV. **I**N Sept. 1719. feeling an acute pain in one of my feet, at the joint between the foot and the little toe, which I imagined to proceed from the more than usual thickness of the callus; I caused my servant to take it off and let it fall upon a blue paper. It was composed of little scaly shivers lying upon one another, and the whole piece was as large as a small nail of a man's hand. I viewed the said shivers through a microscope, but could not satisfy myself, because they lay so irregularly on each other. I took a little bit of it, laid it on a clean glass-plate, steep'd it in pure rain-water, and gently dividing it with a piece of quill, I was amazed to see into what a vast number of particles it separated, and that with as much readiness as if they had never been joined.

Of the callus of the hands and feet. By Mr. Ant. Leeuwenhoek n. 373. p. 156. Sept. &c. 1722.

These particles were very thick in proportion to their bigness, and many of them were of the figure of a weaver's shuttle, broad in the middle and pointed at each end, with a line in the middle, like those upon the uppermost or outside skin of fruits, or of our bodies, but generally irregular. I took two or three of them which I laid on a clean glass, and put to them a drop of water as large as a coarse grain of sand; having divided them as well as I was able I viewed them through a microscope, and was astonished at the prodigious number of exceeding small particles that occurred to my sight, and which were of the same figure as before said.

I took some of the thickest pieces of the horny skin, but not half so thick as the back of a small knife, and having slit them into as thin slices as I could, I placed them upon a clean glass, with a design to discover the exceeding thin particles lying upon one another; and having moistened them they spread themselves out further, and when they became dry again they separated into several parts; each of these separated parts were composed of many thinner particles lying on each other. In order to have a clearer notion of the contexture of these particles, by which the skin of the hands and feet of those who are inured to hard labour increases in thickness, I caused a small portion of the afore said separated particles to be drawn, as appears by fig. 66. ABCD, though they were not all so exact and compleat as they are represented, and according to the best of my observation they had all been separate pieces, and none of them united to one another.

Fig. 66.

Again I placed several little pieces of this hard skin, which I had cut off at the thickest part of it, before a microscope, and moistened them with fair rain water when I put them upon the glass-plate, by which means they acquired a great extent; and being dried they shrunk again, and thereby appeared in several long particles, each of them seeming to consist of other long particles, as they are represented in fig. 67. EFGH. So that EH or FG, was the thickness of that piece of thick skin which I had cut through.

Fig. 67.

Fig. 68.

From this observation I considered with my self, whether one of these long stripe-like particles, such as appear to the eye at EF or HG, might not be the thickness which the horny skin had acquired in the space of a month; and whether the very thin particles, which appear in such a little stripe, were not the accretion which the hard skin received in one day. This last mentioned little piece, represented by fig. 67. was not so large to the naked eye as a common grain of sand. And whereas I placed before a microscope another very small piece of skin, that was something thinner than the former, I could perceive the exceeding thin particles represented by fig. 68. IK LM, which were the strata, or beds, in which the horny particles of the skin lay, and so composed the thickness thereof.

For my further satisfaction I sent for a mason's servant, who was a laborious workman, and cut out of his hand where it was most thick and brawny two bits of the hard skin; and then I slit it into small slices, and observed easily enough the thin particles lying upon each other, but could not separate the little scales, of which each little stratum of the hard skin consisted, because, as I fancied, through the hard working of the man, the particles of the said skin were so pressed upon one another and so closely joined that they could be no longer separated.

As the hands of masons or bricklayers are often covered with the sharp salts of the chalk or lime, which might prevent the separation of the very small parts of the hard skin; I sent for a master-carpenter, who was likewise a diligent workman, and viewing his hands, in order to pare off some of the brawn thereof, I found them as soft in the palms as if he had never been used to labour; upon which I said to him, you wash your hands very often I believe: to which he replied, ten times a day at least, for I hate to see them foul. Then I sent for a ploughman, who was mostly a tiller of corn-land; this person's hands were very hard; I cut two pieces of horny skin out of them, and sliced them into little bits; but they were so hard that a sharp knife got several notches in doing it. And I observed that the uppermost part of the skin was full of little rents, and all the strata were pressed so closely together, that I could not make any discoveries therein, save only that the little beds lay on each other, and that the thickness of the skin consisted thereof. I put these two pieces of hard skin into warm water, in order to soften them and then to separate the parts from each other, but could not do it because they were so strongly joined together.

I have several times observed, in washing my hands, that when I rubbed the palms of my hands strongly against one another, with very little water between them, some particles would be rubbed off from the skin and continue between my hands.

For my farther satisfaction in this matter, I put one of my fingers into fair rain-water, and with that washed the part of my thumb which

Fig. 49.



Fig. 50.



Fig. 51.

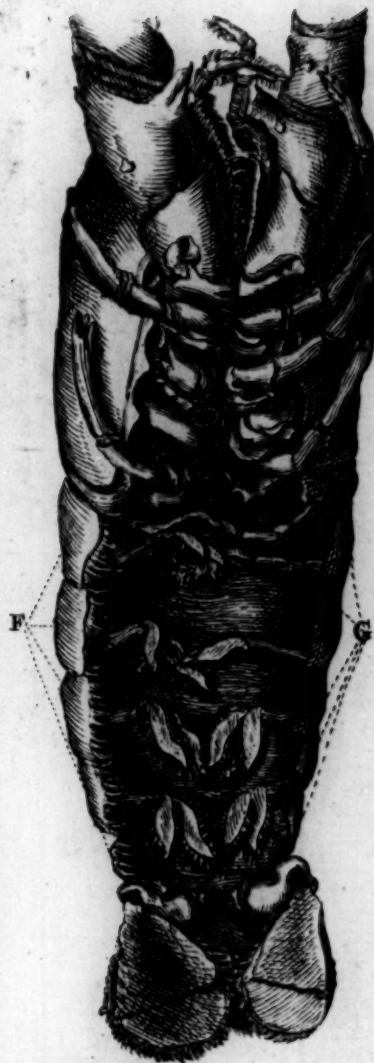


Fig. 52.

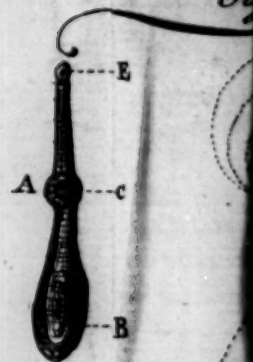
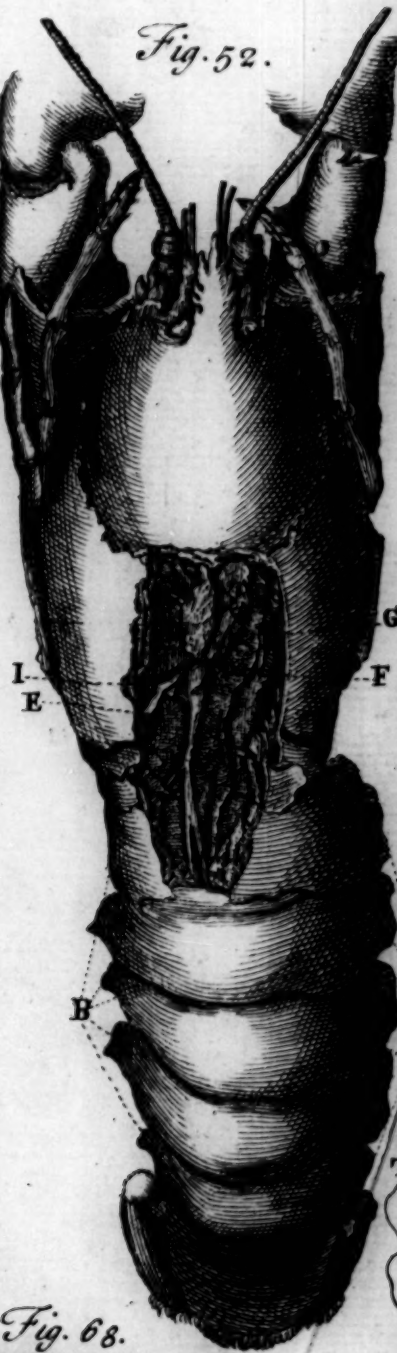


Fig. 57.



Fig. 60.

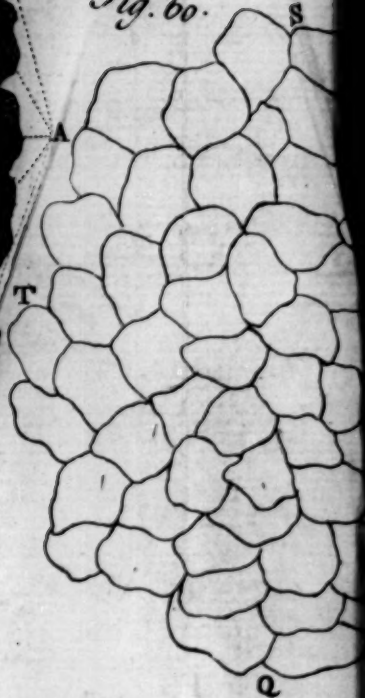


Fig. 66.

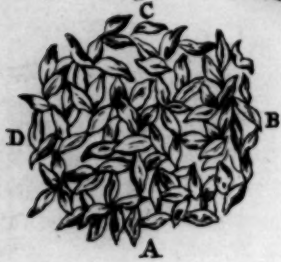


Fig. 67.

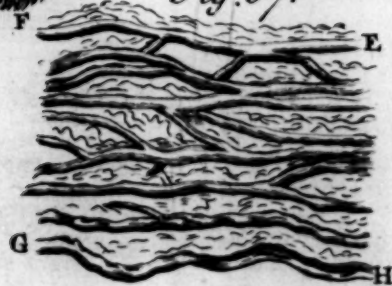


Fig. 68.



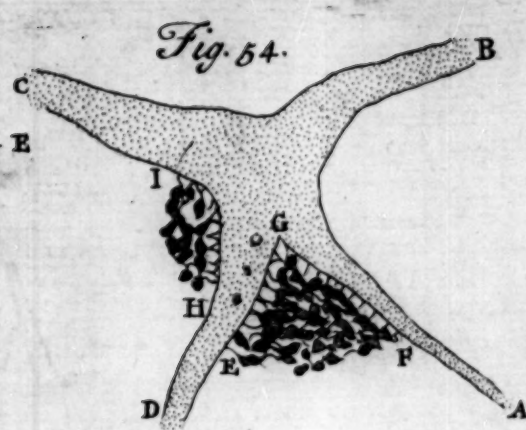
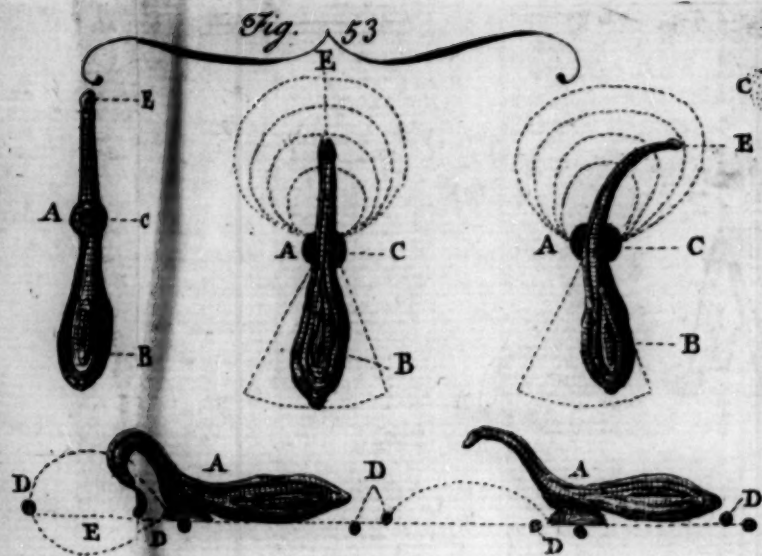


Fig. 61.
WQV

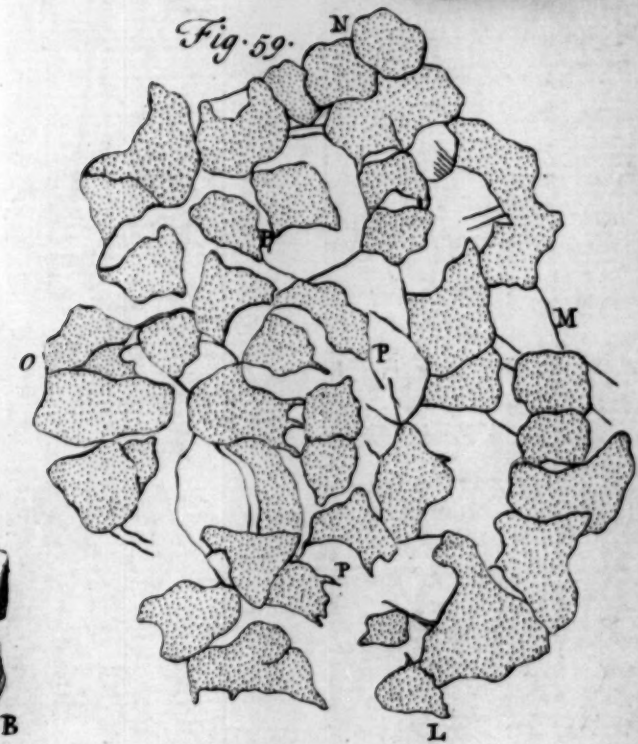
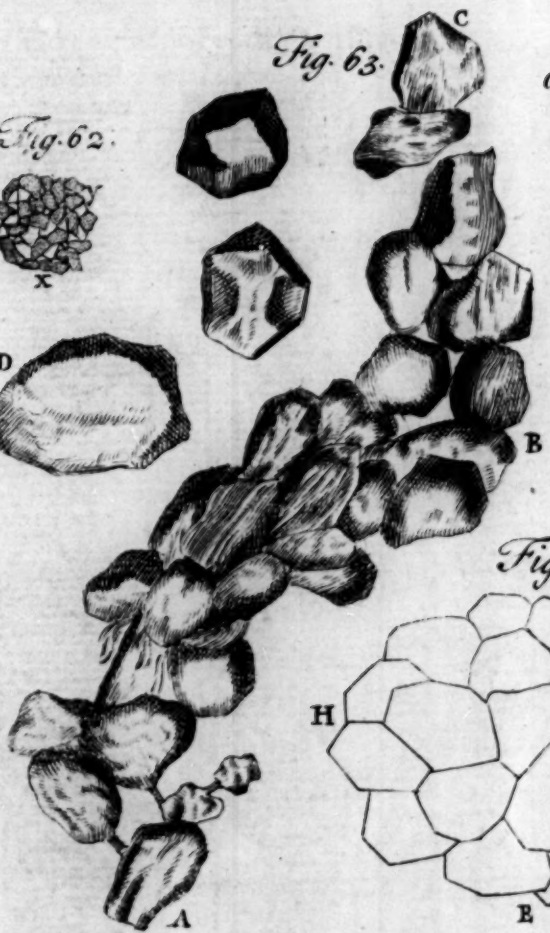
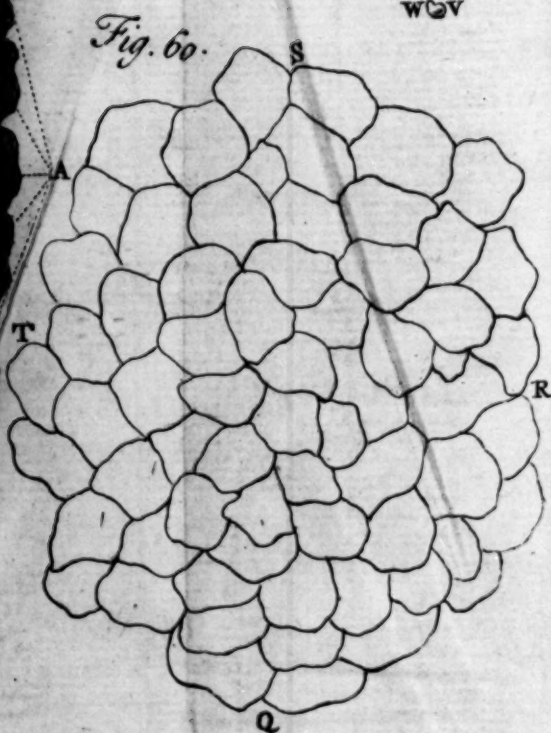


Fig. 65.
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J. Mynde sc.

which is joined to my hand ; after which I rubbed both finger and thumb hard against each other, then I gently scraped with a penknife the matter which I had loosened from the skin by moistening and rubbing it ; and taking off a little of that which stuck to the knife, I put it upon a clean glass-plate, and setting it before a microscope, I saw with astonishment the great number of particles of skin which lay scattered upon the glass, but were more irregular than those which I separated from the brawny skin of my foot, and which were not very closely pressed together, because I don't walk much.

After this I moistened the back of my hands, and then rubbed them ten or twelve times against each other, and having so done I scraped off with a penknife very gently some of the matter which I had loosened by rubbing ; and placing it on a clean glass I viewed it with a microscope, after having separated the particles of the said matter from each other with a little water, and discovered abundance of little scales which come off our hands.

As the skin of my hand is in no part thicker than that which is upon my thumb next to the nail, having chiefly used my thumbs in the examination of microscopical objects, I made one of them a little moist and rubbed the other against it, and placed the rubbed off matter before a microscope, through which I observed such a prodigious number of particles, like those represented by fig. 66. ABCD, but all irregular, that no man can conceive it without having seen it.

Now as we find that such a quantity of particles is separated from the hands and is daily renewed in a well constituted body ; we must conclude that we eat several of the said rubbed off particles in our bread, and that they turn to nourishment ; and I am of opinion that there is hardly any food prepared for us, especially such as passes pretty much through the hands, but that some of the rubbed off particles are mixed therewith, especially when they knead dough from meal or flower ; and still more, when the bakers knead with their feet, as in making of rye-bread.

Since these observations concerning the friction or rubbing of my hands, I take more notice thereof when I wash and dry them than formerly ; and I stand amazed at the numerous particles that daily separate themselves from my hands and grow on them again ; and at the particular provision that is made for producing these particles in the palms of our hands and bottom of our feet, whereas we do not by far meet with such a quantity of particles constantly produced in other parts of our body ; for if we observe those who work much with the backs of their hands, we shall not meet with any of that hard skin we have been speaking of, but only a kind of tumor or rising as the dry-sheerers or those who dress cloth have upon their left hands. The manner of the production of these small particles will be a mystery to us, though our hands and feet must be fortified with

such

such a matter, to enable them to support all that force and pressure which they are obliged to undergo.

*An aneurysm
of the aorta.
By Dr. Pierce
Dod. n. 402.
p. 436. Apr.
Æt. 1728.*

V. 1. **A**N aneurysm, without doubt, is a tumour arising from some disorder in an artery; but what that disorder is or whence it arises is not so well agreed; the accounts which are given of it being widely different and uncertain. The name seems to imply that it is a dilatation of the vessel; but Galen describes it to be a tumour which arises not from any dilatation or relaxation of an arterial vessel and the blood therein contained; but from an extravasation of the blood from some rupture of the artery. Agreeable to this are the opinions of all the rest of the antients, as likewise of the Arabians who borrowed most of what they have from them. Fornelius, as it is said, is the first who maintained that the artery was only dilated and not burst in an aneurysm, and that the blood was contained within the coats of it as it is within those of the vein in a varix; which is therefore called by some, *ἡ φλέψ ἀνευρυσμίνη*. Sennertus makes it to be a dilatation, not of both the coats but of the outward one only, the inner or muscular one being first bursten, and he is followed herein by most of those who have succeeded him, excepting Wiseman and some others, who tell us, that it is nothing but an extravasation of the blood bursting through the coats of the arteries into the interstices of the muscles, and there forming a tumour suitable to the cavity that it findeth, the artery remaining undistended or undilated all the while; and that in all those aneurysms which have come to be examined both the coats of the artery have constantly been found open.

This being the state of opinions with relation to an aneurysm, we had lately an opportunity of examining further into it, by means of a patient in St. Bartholomew's hospital. She was about four and thirty years of age and of a good constitution, but there was a tumour bigger than one's fist, which began from the upper part of the sternum between the origins of the muscoli mastoidei, and extended itself to the pomum Adami almost up to her chin, and possessed all the breadth between the two carotid arteries. The account that she gave of the occasion of it was, that her husband being a passionate man, took her by the throat one day as she was crying out upon some occasion or other, and griped her so hard as almost to throttle her. She was then with child, and immediately perceived something of a pain a little above her heart, and a few days afterwards there appeared a tumour about the bigness of the top of her finger just above the sternum, and so continued without encrease or pulsation till she was brought to bed, when it began to be enlarged upon her having a hard labour; agreeable to what practitioners have observed, that accidents of this nature often happen to women in labour. This was about four years since, and from that time it had continued gradually

encreasing

increasing until it was arrived to almost the highest pitch of extension; and she had all along been troubled with a palpitation, pain and straitness within the thorax, great interruptions in her rest, and frequent sinkings, together with a constant beating along the chest up to the tumour; in which likewise there was a pulsation correspondent to the regular pulse, shaking the tumour at every stroke and manifest to the eye as well as the touch. Notwithstanding this she was otherwise hearty, had her menses regularly, had a good appetite and was mostly chearful and lively, and never more so than just before the fatal period of the tumour.

The apex of the tumour, which was towards the middle, in the prominent part of it was beginning to mortify through an over distension, and the common outward integuments were the first that seemed to suffer: but the distension continuing the mortification increased, and was quickly communicated to the outer coat of the artery likewise, which therefore sloughed off as well as the other integuments, and being at length wore away, just at the extremity made a sudden aperture, about twice the bigness of a goose's quill. The blood instantly gushed forth, as from a stream or torrent, and the poor patient died in less than a minute.

Upon opening the body we began from the heart, in which there was little remarkable, except that the left ventricle was somewhat larger, as were likewise the columnæ carneæ, than they naturally should be. There was little observable likewise in the aorta itself till we came to the curvature; upon the upper side of which was the basis of the tumour, forming a cylindrical stem of four inches long while in the cavity of the thorax; but extending itself into a circular form of a larger dimension when it became external. Upon opening the under part of the aorta opposite to this basis, and carrying the incision throughout its whole extent in the thorax, the trunk retained its usual form and dimensions, and was not at all dilated; but in the upper part above described, just on this side the orifice of the right subclavian artery (which was nearer than usual to the orifice of the left carotid) there was a preternatural circular aperture of half an inch diameter. Upon dividing this aperture, and carrying on the incision to the apex of the tumour, its whole internal substance appeared. The edges of the aperture at the basis of the tumour were hard and almost cartilaginous, and seemingly the remains of thick and fleshy fibres; which upon a nicer inspection they appeared to be in fact, viz. the broken fibres of the inner, or what is commonly called the muscular coat of the artery: which terminating here, the tumour immediately increased to two inches in diameter, and continued of that dimension till it came out at the neck between the clavicles; but then extended itself circularly to a diameter of above three inches, the covering of which was nothing else but the outer coat of the same artery all along dilated from the base, even to the extremity of the tumour.

tumour. The cavity was for the most part filled with a sort of polypus or sarcoma; in which nevertheless there were three sinuses or passages that were kept open by the constant influx of the blood, and communicated near the apex with one another (that in the middle being the largest) and terminating in one towards the extremity of the tumour not far from where it broke.

Such was the state of the aneurysm in this subject; what it may be in others future enquiries must determine.

*Observations
on aneurysms
in general, and
in particular,
on the forego-
ing. By Dr.
F. Nicholls. n.
402. p. 440.
Ap. &c. 1728.*

V. 2. **A**N aneurysm is by all authors defined to be a soft circumscrib'd tumour, in which there is a sensible pulsation, contemporary with the pulsation of the artery to which it adheres. As it is certain that any tumour of what kind soever lying on or adhering to any considerable artery must necessarily be moved by every pulsation of such artery, so this pulsation (unless understood in such manner as I shall hereafter explain) can no ways be admitted as the true diagnostic whereby to specify the difference between this kind of tumour and any other.

An aneurysm is found most commonly to succeed falls, vomitings, labour-strains, and such other motions or indispositions of the body as, by compressing the great branches of an artery, any ways stop the progressive motion of the blood. It is obvious that as the section of the artery above the compressure must in its natural state be sometimes very incapable of containing at once the whole quantity of blood which ought only to have passed through it successively; and as the force of the heart may frequently exceed the resistance it may meet with from the coats of the artery; so the consequence of such a stop to the progressive motion of the blood may occasion either a rupture of the artery, or a distension of the artery without a rupture, or a rupture of the internal coats of the artery and a distension of its external coat. A rupture of the large branches of the aorta necessarily allows so plentiful effusions of blood as to occasion immediate death; while the capillaries may be burst without any other injury but a slight ecchymosis, and the tumour formed by the effusion from them will be diffused and superficial. A rupture of the mean branches (such as descend between the tibia and fibula, the radius and ulna, &c.) will be attended with a considerable effusion of blood; but as the blood will find a passage between the interstices of the muscles it will never form a circumscribed tumour. However the effusion being continued per saltum through the ruptured artery will give a faint pulsation, and consequently some resemblance of the aneurysm; for which reason it is by some surgeons termed a bastard-aneurysm.

Whether or no an aneurysm be a tumour formed by the dilatation of the artery, or by a rupture of the internal coats of the artery and a distension of the external, has for some time been a matter of great dispute;

dispute; each party protesting (perhaps too unjustly) against the possibility of the others opinion.

As to the possibility of an artery's being dilated, it stands supported by reason and autopsy. We find the uterine arteries constantly increase in thickness and diameter in proportion as the uterus is distended; and many cases of palpitations of the heart have been attended with great dilatations of the aorta; instances of which I have seen both in human and brute subjects. Such a dilatation will necessarily follow a constant or frequent pressure on any part of the aorta, provided such pressure does not entirely stop the progressive motion of the blood through the aorta. But on the other hand, such a dilatation will always retain somewhat of the form of the artery. The resistance will not be every way equal, as in the extravasate tumours; because the quaquaversal pressure of the blood will be controlled by the pressure on the artery and the resistance from the coats of the arteries, so as necessarily to form a cylindroid. And the consequence of such a dilatation cannot (if considered abstractedly from its pressures) be worse (if so bad) than from a varicous vein.

Again, they who conceive an aneurysm to be a rupture of both coats of the artery oppose their opinion who imagine the internal coat to be ruptured and the external to be distended, by comparing the two coats in question, and urging that as the internal coat is so much thicker than the external it seems impossible the last should be sufficient to resist a force capable of destroying the first. Were these two coats similar as to their structure we might then compute their strength by their thickness, and this argument would be of much greater force than at present it can be; because the internal coat being composed of annular fasciculi, whose sides have but a very weak cohesion, their power of resisting will not be measurable by the strength of those annuli, but by the force with which they adhere laterally. And on the other hand, the external coat being composed of fibres equally interwoven and of a quite different composition, it may either exert a greater resistance, or be capable of much greater dilatations than the internal. But that autopsy may evince the truth of this difference in the strength of these coats, it will be found by any one who pleases to try the experiment; that by blowing into the pulmonary artery the internal coat will soon burst, and the external form itself into aneurismatic tumours.

Upon considering all which, and having by order of the society both privately and publickly examined the aneurysm before us, which I find to be round like other extravasate tumours, unless when controlled by any notable pressure, and that the sacculus does not divide into coats as the artery from whence it arises does, I am induced to think that this aneurysm is a tumour formed by the blood's being forced through the ligamentous, or what is called the muscular coat, and distending the membranous or outer one. And because the

impetus of the blood will, as it were, perpetually press through the aperture into the tumour, and be again (at least in part) returned by the elasticity of the external coat; therefore such a tumour will rather have a pulsatile dilatation, than a pulsation for its true diagnostic.

A very singular Nævus Maternus, or Mole, communicated by Dr. Steigertahl n. 389. p. 347. July &c. 1725.

VI. **J.** Rud. von Walthausen a captain of the garrison at Danneberg near Lunebourg, was born Oct. 24, 1680, with a very singular mole upon his right arm, shoulder, and hind-part of his side, not unlike the branch of a vine with its leaves and grapes. It hath been affirmed and attested both by the deceas'd himself and several of his relations and friends, that his mother when big with child longed for grapes, and impatient to stay till they were full ripe went down into the garden to gather some of those unripe; whereupon it happened that a whole branch with its leaves and grapes suddenly fell down upon her right arm and much frightened her. Some time after she was brought to bed, and the child was observed to have several reddish or bluish spots beginning from behind his shoulder, and from thence running over the same down the right arm to the fingers. The captain's whole right side was bigger than the left by an inch and upwards, and so continued to his death. The veins of the right arm were much raised, lying almost immediately under the cuticula, which made them very conspicuous; they were besides very much distended, chiefly between the elbow and hand, where they were almost as big as a man's thumb. On the inside of the fore finger the vein was extended into a small tumour, of a reddish or purple blue colour, about the bigness of a nutmeg, corrugated with some lenticular protuberances, which made it in some measure resemble a grape. The like tumours but not so big were observed in several other parts of the arm in the spring time; and as they thought when the sap began to enter the vines, as also when the vines flowered, and in autumn when the wine was fermenting, he was taken ill with violent and itching pains in the affected arm for some days. The whole right side then swelled more than usual, and the veins and tumours abovementioned were so distended with blood, that at last a serous matter was forced out of the pores of the said tumours, which as it gave the patient some relief so he promoted it by scraping the tumours with the edge of a penknife. If the captain held up his affected arm, the running of the blood backwards in the distended veins was very visible. If he held his arm down again, the blood returned with some noise and sensibly filled the vessels which by the preceding action had been emptied. For this reason, he was obliged to lay his arm upwards in bed. In Feb. last he was taken ill with violent pains and a strong sensible pushing of the blood into the affected arm, for both which, they being not only more violent but continuing longer than usual, he was advised to be let blood in his left arm; as this did not immediately relieve him, they applied at his desire externally

epithemata

epithemata of plants boiled in wine ; this eas'd his pains and made him somewhat more quiet, so that he could walk about the house, but he nevertheless continued restless for some days, and Feb. 17. early in the morning was seiz'd with a violent oppression of his breast which in a few minutes made an end of his life. The surgeon then present did not bleed him, but gave him only some spoonfuls of a strong cordial mixture, which he happened to have about him, and of which the patient with much difficulty could swallow but a small part. He was when he died forty four years three months and twenty four days old ; he was otherways a strong robust man, could endure much fatigue, and discharged with great bravery all the duties of a good soldier, as appeared by his conduct throughout the last war.

VII. **M**R. Consett of Cleveland in Yorkshire, a gentleman of sixty seven years of age, who all his life before had enjoyed a perfect good state of health, sent for me on account of a mortification which began about a month before on one of his toes, and by gradual advances in that time had reached half way his leg ; and this without any manifest cause. He saw himself dying daily by piece-meal ; but heart-whole as he expressed it, and had a pretty good pulse. I propos'd amputation as the only remedy, which (I told him) would give him some chance for his life, though the odds was against him. This he readily consented to ; and as soon as I could get my dressings ready, I went about the operation. The leg being taken off at the usual place, which was four inches above the mortification, about two or three ounces of blood issued out from the muscular part ; but upon slackening the turniket in order to look for and tie the artery not one drop of blood flow'd out ; to my no small surprize. And upon feeling the extremity of the artery I found it hard and callous ; however I secured it by a ligature as usual and dress'd the stump. The patient (who had born the operation with the greatest resolution) being put to bed, I was desirous to examine the leg ; and having dissected the artery with its two considerable branches as far as the tarsus I found them for the most part ossified ; that is to say, the trunk where it was amputated was ossified about two thirds of its circumference. About a quarter of an inch lower the whole was bony, leaving so small an orifice that it would only admit of a hog's bristle, not a very fine probe which I endeavour'd to introduce. A little lower it was on one side bony, on the other membranous ; then again an entire case of bone. Here and there for the breadth of a barley-corn there would be no bone at all. I opened about two inches of the internal branch immediately above the malleolus, it appearing blacker than the rest. After it had been wash'd I found in it about two or three drops of coagulated blood ; and now it is expanded and dried, it is one entire lamina of bone as

*An ossification
of the crural
artery. By
Mr. Edward
Naish. n. 369.
p. 226. Sept.
Æt. 1721.*

thick as the shell of a pigeon's egg and of an unequal surface. I dissected three ramifications of this internal branch into the foot; only one of them had a very small bit of bone in it, about half an inch from the trunk. The other great branch that runs on the ligament which ties the foci together was not so much ossified as that which I have described. The bony shell or lamina was contained within the coats of the artery.

This ossification (which is the compleatest of any I have yet heard of) was no doubt the cause of the mortification and of my patient's death, which followed four days after the amputation. I should have been curious to see how high the ossification reached, but was obliged to be elsewhere when he died. I doubt not but these cases are more common than we imagine. For when we see mortifications seize the extremities of aged people, which we commonly attribute to a decay of nature, or an extinction of the vital warmth, this I believe is often the cause. And I am the more inclined to think so from two or three parallel cases which I have been concerned in since I came into Yorkshire.

*Of the causes
of the gout.*

By Sig. Michele Pinelli.

n. 403. p. 491.

July &c.

1728.

VIII. **I**N order to discover the nature and cause of the gout, I have for some time applied my self to examine the several parts of the human body whether solid or fluid, and by chymical processes to dissolve them into their primitive or constituent parts. Thus I have found, that the solid substance of the bones and the circumambient parts is composed of phlegm, oil, an alkaline volatile salt, and a little earth. The same principles I have also constantly discovered in the blood and all the other fluids which are secreted from it, as well as the other solid parts, with this difference only, that there is more phlegm and less oil and volatile salt in the fluids than may be extracted from the solids. Carrying these experiments still further, and endeavouring to extract *viâ humidâ*, as the chymists call it, the salt from the excrements in the stomach and intestines, I have constantly found a salt not unlike sea-salt and appearing upon examination to be a perfect acid. And yet with all possible art and carefulness whatever nothing of this acid salt could ever be obtained from all the other solid or fluid parts of the body. Hence it appears how much those must be mistaken who have hitherto asserted, that the cause of the gout is a coagulating acid existing in the blood, since nothing of an acid is found in any part of the body but the excrements. This put me upon thinking that the cause of the gout may be owing perhaps to that other saline principle which chymical trials shew us to exist both in the solid and fluid parts: and I have been confirmed herein by the following experiments.

A very gouty person dying lately at Rome, I procured as much as I could of that tophaceous gouty substance commonly found about the joints of persons afflicted with this distemper: and having got about

about three ounces and a half, I took six glass bottles and put ten grains of it into each. The first of these bottles I filled with distilled vinegar, the second with spirit of vitriol, the third with spirit of salt, the fourth with spirit of sal-armoniac, the fifth with spirit of hartshorn, and the sixth with spirit of urine. After four and twenty hours I found the aforesaid tophaceous matter totally dissolved in the three first bottles which contained the acid spirits, but in the three others which I filled with alkaline spirits it remained entire and untouched, even for some time after. From hence I concluded this tophaceous matter to be of an alkaline nature, forasmuch as it is the nature of acid spirits to dissolve such substances as are either altogether alkaline or composed in part of an alkali. And this also I conceived to be the reason why the aforesaid tophaceous substance remained entire in the bottles filled with alkaline spirits, both being of the same nature and consequently not to be dissolved by each other.

But for a farther satisfaction, I took the remaining part of this tophaceous matter being about three ounces and put it into a small retort. Then having fixed a recipient to it, I distilled it according to the rules of art by a gradual fire, and obtained a spirit with some few drops of oil, about two drams of a caput mortuum remaining in the retort. This spirit I found to be a perfect volatile alcali, altogether of the same nature with that which is extracted from blood, from urine, and from bones. Hence again it is evident, that this tophaceous gouty substance is composed of the same principles with the other fluid and solid parts of the human body, or, that the cause of the gout is nothing else but a volatile, alkaline, corrosive salt, which by corroding the sensible membranes about the joints occasions acute pains in these parts.

IX. **J.** Hen. Oizmann, aged thirty one, was fifteen years old when the following misfortune befel him.

He felt a spasms or cramp in his left hip and the inferior part of his leg; as this pain seized him pretty often, he consulted a surgeon who applied several plaisters to the place where the pain was, but without any relief to the patient. After all those fruitless efforts, the surgeon, to see whether Oizmann had still a feeling in his leg (which to outward appearance was become very brown) made about thirty seven incisions in several parts of it, whereof the patient was not at all sensible, unless the instrument happened to grate upon the bone, the periosteum being as yet sound and not infected by the disease of the flesh. The leg however grew daily blacker, and the pain continued both in the periosteum and in all the bodies of the superior and inferior part of his leg. At last a black circle was seen round about the muscles of the hip as an indication of an approaching putrefaction. This circle appeared as visibly as if it had been cut off with a knife from the other part. It continued to spread and came to such a head

*Surprising
effects of a
cramp. Com-
municated by
Dr. Steiger-
tahl. n. 365.
p. 79. May
1720.*

head that without any help or cure the flesh gradually rotted away from the bones; and at last fell quite off from the superior part of the leg which preserved its soundness. After this nothing was seen but the bare tendons or sinews hanging down like so many strings or cords. There remained also one piece of the inferior muscles of the hip fastned to the superior part. At length the tendons growing dry consumed away, and the os femoris wholly dropt off in such a manner that there remained about four inches betwixt the bones and the flesh loosely hanging down from them. The flesh at last grew up to the bones and without any assistance fastned itself to them. And in this sound part the patient feels a great pain whenever the weather proves tempestuous. It is remarkable that at the same time he had also a swelling in the right tarsus, the matter whereof discharged itself through the toes, and was of so corrosive a nature, that it consumed them all but the little one. The surgeon at last healed up this wound; but after all there is but little feeling or warmth in the foot.

*A remarkable
fistula. By the
same. ibid.*

X. **T**HE man whose case is related in the preceding section has now been married about seven years to a woman whose bodily constitution is almost as remarkable. She is in the forty first year of her age. In her younger years she had the misfortune to be goared by a wild boar under the short ribs of the left side. Of this wound she has a fistula to this day; what food she eats dischargeth it self half concocted through this opening, which she is therefore obliged to clean frequently; notwithstanding this she has her daily evacuation per anum. It is remarkable that the victuals discharged by the wound are still distinctly known what kind they have been of.

*Uncommon tu-
mours. By Mr.
Joseph Atkin-
son Senior. n.
389. p. 340.
July &c.
1725.*

XI. **A** Maiden about twenty years of age was brought to me about Christmas 1723, who had a tumour on the inside of her right thigh, extending from the groin to the knee, and so large that I judged it contained at least a gallon; the cutis was exceedingly distended, but of the natural colour, only the capillary veins appeared varicous and very numerous; she had also a large tumour on the buttock of the same side as big as a quartern loaf; but when the tumour on the thigh was pressed that above very much encreased, which shewed a communication between them. She had also another tumour on her right side, stretching from the left side of the vertebrae of the back to the hypochondrium, about the bigness of a penny loaf; her body was very much emaciated, and she could hardly breathe, and the little victuals she eat passed out of the stomach with great difficulty. She had had the menses but twice or thrice, about twelve months before the beginning of those tumours, and it is to be marked that the tumour of her thigh began first and increased to near the magnitude I first saw it at, before that of the buttock and hip began; and last of all the tumour of her back appeared, which

as it increased brought on great difficulty in breathing. She had been with several other persons who advised against opening the tumour of her thigh, most of them being of opinion it was from blood and that her case was incurable: I confess I was of a contrary opinion; but being told what so many others had said, I declined meddling with it then though both she and her parents were willing: I dismissed her therefore, saying that if she lived a little time would discover more of her case. About two months after I was desired to visit her again, which I did and found the tumours so monstrously increased and her body so wasted, that I wondered she could live; the tumour of the thigh yielded every way to the pressure of the finger, nor was there the least hardness about its extremities, so that it might be easily mistaken for an aneurysm, had it not wanted the grand characteristic pulsation, which some say is not to be felt when they are very large, the middle of this then looked a little red and shining, and seemed to point a little; I told them I believed it would break with a small orifice and shew what was contained, desiring them to let me know if it happened so: three days after they called me in haste, telling me that the swelling of her thigh was broke; when I came I found there had been discharged a small quantity of matterish substance, much like what is contained in a meliceris, but the opening was so small or close, that I could not enter my probe; however, though she seemed ready to expire, yet at the desire of her parents I opened the tumour with my lancet, making an incision about an inch and an half long, through which poured about five quarts of matter, which was very fetid and bloody towards the latter end of the discharge: upon this the tumour wholly subsided, so that the thigh instantly became as small as the other; I put my finger into the wound, and found the fascia lata quite consumed, the muscles lay all loose so that I fairly touched the thigh-bone between them as I would. Immediately upon this discharge the tumour on the buttock was considerably abated, but there followed about two or three spoonfuls of florid blood; I dressed it up with a proper digestive and bandage; the next day I visited her again, and found she had slept pretty well and was much refreshed, without the least faintness during my absence, which shews the fear of a syncope after such evacuations to be groundless; the day following I took off my dressings and found the limb but little bigger than the other; at the third dressing there appeared a small hard swelling a little below the orifice, caused by about four ounces of grumous blood which I turned out with my finger; this was followed by a florid blood which much surprised me; I judged it to proceed from some hypogastric vessel that supplied this tumour, and I despaired of success unless I could meet with the spring; in order to which I laid open the sinews to the groin, and though I could not discover the vessel, yet I so successfully applied my astringent that from that time it bled

bled no more ; yet there was for a week a great flowing of a serous matter, which wholly sunk the tumour of the buttock and hip, and by bouldstering and compressing with suitable bandages the so long separated cutis clos'd with the muscles, and all things in about a fortnight seemed to be in a fair way of healing, yet it was near three months before the cure was compleated.

But still (that is a fortnight after the opening of the thigh) the tumour on her back continued, and she was much straitened for breath; saying if that was opened she should be presently relieved; I therefore opened it and there issued out above two quarts of matter: I was again greatly surprized at the quantity, so much more than the visible tumour could possibly contain; I entered my probe which penetrated into the cavity of the thorax, between the second and third spurious rib reckoning from beneath, on which she respired with all freedom, but there was a halitus at the wound; I continued to dress it and believe that before it tended towards healing it discharged, at times, no less than five quarts of matter; but when I thought all was over it filled again, the external tumour became almost as big as before, and her breathing as difficult as ever, so that I now thought all my labour had been in vain; yet I opened it again with a larger orifice, and from that time dressed it successfully to perfect healing; the menses returned and the patient continues to this day well and in a good state of health.

The way of inoculating the small pox in N. England. Communicated by H. Newman Esq; n. 370. p. 33. Jan. 1722.

XII. 1. **W**E make usually a couple of incisions in the arms just where we make issues, but a little larger than for them; sometimes in one arm and one leg. Into these we put bits of lint, (the patient at the same time turning his face another way and guarding his nostrils) which have been dipt in some of the variolous matter taken in a vial from the pustules of one that has a small pox of the more laudable sort, just turning upon him, and so we cover them with a plaister of diachylon. Yet we find the variolous matter fetched from those that have the inoculated small pox altogether as effectual. Nay, what is taken from them that have the confluent sort is as good as any. After twenty four hours we throw away the lint, and the sores are dressed once or twice every twenty four hours with warm cabbage leaves. The patient continues to do all things as at other times, only he exposes not himself to the weather if it be at all intemperate. About the seventh day he feels the usual symptoms of the small pox; and is managed as in an ordinary putrid fever. If he cannot hold up he goes to bed; if his head ach too much we put the common poultice to his feet; if he be very sick at stomach we give him a gentle vomit; nay, we commonly do these things whether we find the patient want them or no; and we reckon the sooner the better. If the fever be too high in some constitutions we bleed a little, and to hasten the eruption put on a couple of blisters. About the

third

third day from the decumbiture the eruption begins. The number of the pustules is not alike in all, in some they are very few, in others they amount to an hundred, in many to several hundreds; and frequently to more than what the accounts from the Levant say is usual there. Upon the eruption all illness vanishes; except perhaps a little of the vapours in those that are subject to them; there is nothing more to do but to keep warm, drink proper tea, eat gruel, milk pottage, panada, bread, butter, and almost any thing equally simple and innocent. Ordinarily the patient sits up every day, or even ventures upon a glass of wine. If he be too intent on study we take him off. Sometimes, though he be on other accounts easy enough, yet he can't sleep for divers nights together. In this case we do not give him anodynes or opiates, because we find that those who take them in the small pox are generally pestered with boils after their recovery. Their sleep returns of itself as their strength increases. On the seventh day the pustules usually come to maturity, and soon after go away, as those of the small pox in the distinct sort use to do. The patient gets abroad quickly, and is very sensibly stronger and in better health than he was before. Women in child-bed have been inoculated eight or nine days after their delivery; and they have got earlier out of their child-bed, and in better circumstances, than ever in their lives; those that have had ugly ulcers long running have had them healed up, and some very feeble, crazy, consumptive people have grown hearty and got rid of their former maladies by it. The sores of the incision seem to dry a little during three or four days of the fever before eruption; after it there is a plentiful discharge at them, which may continue a little while after the patient is quite well on other accounts; but the sores will soon enough dry up of themselves; and the later the better, as we think. If they happen to be inflamed or otherwise troublesome, we presently help them as we do any ordinary sores.

XII. 2. **I**N Dec. 1721 I first began to put this method in practice, and finding it to succeed beyond my expectation in the first instance I was encouraged to repeat it upon some others; and afterwards several, seeing with how much ease these got through the distemper, were desirous to have the same done to themselves or their children; so that there are now upwards of forty here that have received the small pox by incision; who are all got well through the distemper and are at this time in very good health. Only one that was inoculated died: of which I shall give you a particular relation hereafter, and refer it to your impartial judgment whether that ought to cast any blemish upon the operation or no.

What was done by way of preparation was chiefly purging with rhubarb for children, and sometimes vomiting or bleeding for grown persons; and many had no preparation at all. But I always found,

as far as I was able to judge, that those whose bodies were well prepared by such proper methods as their different ages or constitutions seemed to require had more favourable symptoms than others in like circumstances where that was omitted.

The method which I always took in the operation was to make two incisions, one in the arm and another in the opposite leg. It is not material, as to raising the distemper, whether the incisions be large or small; but I commonly found that when they were made pretty large the quantity of matter discharged afterwards at those places was greater; and the more plentiful that discharge the more easy the rest of the symptoms generally are, and they are also by this means best secured from any inconveniences which might follow after the small pox are gone off.

At first I collected some of the matter from the pustules of one who had the small pox of the natural sort into a shell or vial, and infused two or three drops of it into the wound; but finding it to be very difficult to get any quantity of the matter, and observing also that the least imaginable will be sufficient, I commonly take small pledgets of cotton, and ripping the pustules when they are ripe with the point of a lancet, roll the pledgets over them till they have imbibed some of the moisture. I put one of these upon each wound, and cover it with any common plaister till the next day, when I commonly take away both the cotton and the plaister, leaving the wound to itself, only covering it with a slight linen roller to defend it from the air. I have sometimes rubbed the pledget only once over the wound without binding it on, which I found to answer the end as well; and from some other observations I made I have been surprized to see the small pox produced this way, when I was very well assured the quantity of matter received into the vessels could not amount to the hundredth part of a grain.

The persons inoculated were not confined to any regimen, but only to be kept moderately warm; and those who were grown up to live very temperate and regular, to keep their minds easy and composed, and to use proper means to drive away all fear and concern. Some have been obliged from the time of the incision to abstain from flesh and all strong liquors; but I found afterwards that the eruption did not proceed so well when they were obliged to live too low. Perhaps in warmer climates where they are not so much accustomed to live upon flesh such abstinence may be necessary; but here I find it best to let them eat and drink as usual, though something more sparingly, till the fever begins to rise; and then, but not before, we enjoin such a regimen as is usual in like cases.

The first thing that occurred after the incision was the inflammation of the wounds, which commonly happened about the fourth day, when they began to appear very red round about and to grow a little sore and painful; in about two days more they began to digest
and

and run. In some they begin to run sooner, and the quantity discharged is much greater than in others. I generally found, that in those who discharged most this way the fever was more slight and the small pox fewer, though I have known some do very well when these places have only appeared very red, but have scarce run any thing at all, as it usually happens when the incision is made so superficial as not to cut through the skin.

About the seventh day the symptoms of the fever begin to come on, which are the very same that we always observe in the small pox of the distinct kind in the natural way. A quick pulse, great heat and thirst, pain in the head and back and about the region of the stomach, vomiting, dosedness, startings, and sometimes convulsions. All were not seized with all these symptoms, nor in the same degree or continuance; some began on the seventh day, and continued ill without any remission till after the eleventh; many not till the eighth or ninth day; and the fever in these was more moderate with great intermissions; and some have scarce had any illness at all. During all this time the places of incision continued to be very sore and swell very much, so as to appear very large and deep, and to discharge a great deal of matter.

On the tenth day the small pox most commonly appeared, sometimes on the ninth, and sometimes not till the eleventh; but I never found that any difference of age, constitution, or any other cause ever made them vary above one day from the tenth. The number was very different, in some not above ten or twenty, most frequently from fifty to two hundred, and some have had more than could well be numbered; but never of the confluent sort. Their appearance was the same with those of the distinct kind, they commonly came out very round and florid, and many times rose as large as any I have observed of the natural sort, going off with a yellow crust or scab as usual; though it sometimes happens, especially when the sores discharge a very great quantity of matter, that they are both few in number and do not rise to any bulk; but having made their appearance for four or five days they waste insensibly away.

After the small pox come out the feverish symptoms gradually abate, and when the eruption is completed they usually cease, without any second fever or any farther trouble in any respect.

While the pustules were rising and for some time after they were gone the sores continued to swell and to run very much, the longer they did so the better; but they never failed to heal up of themselves after a certain time.

I very rarely saw occasion for any medicines in the course of the distemper, only sometimes when the symptoms ran very high I gave a gentle anodyne to be repeated as occasion should require, and once or twice I thought it necessary to blister, and to use such medicines as are found to be most serviceable in the small pox of the natural sort.

After the pustules are gone away they have always been purged twice or thrice, and sometimes let blood, which is all that has been usually done. But though the practice may seem to be very easy, yet it is an affair of such a nature as to require the utmost care, and I presume it will never be undertaken without the advice of physicians to direct a proper method of preparation before the insition is made, as well as a just regimen afterwards; to watch every symptom, and lend nature all proper assistance, whenever it shall be requisite. Where this is done it will seldom fail of being attended with happy success.

It has happened in an instance or two that the symptoms in the distemper have been worse than usual; and some few, after the small pox were gone off, have been subject to other indispositions. Of all which I shall give you a particular account.

The first that was inoculated, a boy about a year and half old, began to be ill on the eighth day and had a brisk fever for two days, then the pustules began to appear, which were but few in number and rose very large. The child was soon well and continued so for about a month, when being carried out and kept a long time in the cold he fell into a feverish disorder accompanied with a cough, and was ill for four or five days; after that time it went off, and he has ever since been in very good health. The second was a girl of two years of age, in a family where they had formerly buried three children successively of the small pox, and this they feared might undergo the same fate. The fever came on about the seventh day and she continued very ill till the tenth, on which day about noon she had a strong convulsive fit. In the evening the small pox appeared, and though she had more in number than usual, yet she grew well as soon as they were fully come out and has continued so ever since. † The eighth and ninth were in a family where they had four children, none of whom had had the small pox. I was called to the eldest who was seized in the natural way with the most malignant sort I ever saw, attended with the worst symptoms that could be, insomuch that he died on the fourth day all full of purple and livid spots. The parents were very desirous that any means might be used to preserve the rest; but here I was in great doubt and perplexity what part to act. I knew very well that if I should venture to make the insition, whatever should happen would be charged upon that, and it was not improbable but some of them might have already caught the infection, in which case it was uncertain what the event might be. On the other hand, if it was omitted I very much feared they might all die, such instances having been known, and the contagion which was got amongst them being of such a destructive nature. Wherefore I was willing to run the risque of my reputation rather than the children should all perish. They were therefore all three inoculated the day

† Mr. John Symson's children.

before the eldest died, after having told the parents that I could not answer for the success in case they had already caught the infection, which would be known if any of them fell ill before the seventh day. As we feared one of them was taken on the second day much after the same manner with the eldest, and the small pox appeared on the third day, or rather an universal redness all over the skin interspersed with many purple spots. There were none of these spots near the places of infection, which began to swell a little as usual about the fourth day, and the small pox rose a little more about those places than elsewhere; but nature was too far oppressed with the violence of the distemper, and though this girl continued longer than her brother and was not delirious as he was, yet she died on the seventh day. I did not reckon this child in the number of those who received the distemper by inoculation; for I thought there was sufficient reason to conclude that she had taken the infection before. The other two continued well till the eighth day, when they both fell ill together. The small pox came out on the tenth, of a very good sort, though more in number than some others had, and they both got very easily thro' the distemper without any indisposition since. It was observable that many spots appeared on the elder of these children about the time of the eruption, of a deep red colour, very much like those of the other two children in whom they afterwards changed to purples, which the mother was very much concerned at, fearing they would prove the same in this; but when the small pox came out these spots grew gradually less and at last quite disappeared. The other child had been very subject to convulsions for a long time when very young, and it was afflicted with the same very much from the time that the fever came on till the small pox appeared. The twenty seventh was a married gentlewoman aged about twenty six, who got very well through the distemper; but about a week after was seized with a very great coldness and shivering followed by a burning heat, with a great pain and disorder in her head, which continued for several hours. She had some time before had an intermitting fever, of which I took this to be a paroxysm, and expected its return; but she felt no more of it and has ever since continued in good health.

Of her two sons who were both inoculated at the same time the younger got through the distemper with a great deal of ease, the small pox being few and the symptoms very slight; but the elder, a boy about five years old, fared quite otherwise. The symptoms before the eruption were more than usually severe, especially the vomiting; the pustules appeared at the usual time, but more numerous than ordinary, and when the eruption was finished the fever did not cease as it has done in every instance but this: on the fifth day after he was seized his face began to swell, which was followed by a pain and swelling in his throat and a salivation, which continuing till the eleventh day were succeeded by a swelling in his hands and feet, the usual

usual symptoms of the distinct sort when they are very full ; and though there appeared some little signs of malignity, yet with the use of blisters and the milder cordials and alexipharmics the pustules rose very large and all things went on very well, so that he got through the distemper without any danger, but with much more pain and trouble than any of the rest have endured. After the small pox were gone off we found a hard swelling upon his shoulder, which disabled him for some time from moving his arm ; but by the use of some common applications that is entirely gone. In this family the only child they had before these died of a very malignant sort of the small pox, and this boy was of an ill habit and has had many dangerous illnesses. The twenty third was a girl about nine months old ; in this child after she was well of the small pox the mother discovered that one of her thighs was a little swelled, which was painful to her for some time and made her unwilling to move that part ; there were also some small tumours in the groin ; but these went off in a few days, and there remained only a hardness about the knee, which also disappeared in a short time without coming to suppuration, and the child is now in perfect health. The thirty seventh was a girl six years of age ; she got very easily through the distemper ; but before the small pox were gone we found a small tumour upon the muscles of the loins, which ripened very speedily and was opened and healed up in a very short time. Her sister, a young woman about eighteen, had also a swelling of the same kind in her leg, but it lay something deeper and gave her a great deal of pain for three or four days ; afterwards it discharged a great quantity of matter and was healed without any farther trouble.

All the rest, excepting these I have mentioned, got very well thro' the distemper without any manner of trouble or hazard, or any ill consequence afterward. Whether those slight indispositions which some have been subject to afterward were owing to the incision I have not been able to judge ; but I presume what they have endured in the course of the distemper, and what has followed after, is not to be put in the ballance with what is undergone in the common way by those who are thought to come off very well ; and if this method were more generally practised 'tis probable some means would be found out to prevent even these subsequent disorders, which are no more frequent nor near so bad as those which follow the natural sort.

In two instances the inoculation had no effect, the reason of which, in one, was because the child had the small pox before, as the parents believed ; but the distemper had been so favourable as to leave it doubtful. In the other, the matter was taken when the pustules were withered and almost gone, and that little moisture which they contained, I suppose, had lost its virtue ; the boy to whom it was applied was no way affected ; the places of incision did not at all inflame or swell as usual, nor did any pustules appear ; but about a
month

month after he was seized with the distemper in the ordinary way and did very well.

Some of those who have been inoculated and are grown up have afterwards attended others in the small pox; and it has often happened that in families where some children have been inoculated others have been afterwards seized in the natural way, and have lain together in the same bed all the time; but we have not yet found that ever any had the distemper twice; nor is there any reason to suppose it possible, there being no difference that can be observed betwixt the natural and artificial sort, but only that in the latter the pustules are commonly fewer in number, and all the rest of the symptoms are in the same proportion more favourable. There is one observation which I have made, though I would not yet lay any great stress upon it, that in families where any have been inoculated those who have been afterwards seized never had an ill sort of small pox, but always recovered very well.

XIII. 1. **H**OWEVER new the method of communicating the small pox may appear in this kingdom, it has been commonly practised by the inhabitants of this part of Wales (Pembrokeshire) time out of mind, though by another name, viz. that of buying the disease, as I have been long ago acquainted by several who procured the distemper by that means. There is a married woman in the neighbourhood of this place who practised it on her daughter about a year and a half ago; she had the small pox favourably and is now in perfect health, notwithstanding she has ever since without reserve conversed with such as were ill of that distemper.

A method of procuring the small pox in S. Wales. By Dr. Perrot Williams, n. 375. p. 262. Jan. &c. 1723.

In order to procure the small pox to themselves they either rub the matter taken from the pustules when ripe on several parts of the skin of the arm, &c. or prick those parts with pins, or the like, first infected with the same matter. And notwithstanding they omit the necessary evacuations, such as purging, &c. yet I am informed they generally come off well enough; and what is remarkable, I cannot hear of one instance of their having the small pox a second time.

XIII. 2. **A**N ingenious gentleman of this country, one Mr. G. Owen, counsellor at law, solemnly declares that having, when at school about twenty years ago, rubbed the skin off his left hand, where the scar is now very visible, with the back edge of his penknife till the blood began to appear, he applied the variolous matter to that part; which by degrees growing inflamed, about a week afterwards he fell into the small pox of which he recovered perfectly well; and that he has since frequently conversed with such as were sick of that distemper. He says also five or six more at least of his schoolfellows infected themselves at the same time and with the same success. I have since talked with several more, who made the like experiments on themselves, some twenty, some sixteen, &c. years ago:

Continued by the same. ibid. p. 263.

ago: who all positively affirm they never had the small pox a second time.

*Continued by
the same, to
Dr. Jurin.
ibid. p. 264.*

XIII. 3. **M**R. Owen was about fifteen years of age when he made the experiment on himself, and questionless had the genuine small pox; the signs of them on his face, and the mark on his hand where he applied the matter, being still so very visible as to put that matter beyond dispute. The physician who then attended him is dead. Though I can't pretend to remember how many informed me of their procuring the distemper in this manner; yet I can aver that within the compass of twenty years last past, I have been so often assured of the truth of it, not by children but grown persons of undoubted credit, that I am entirely satisfied it has been an immemorial custom in these parts; and not only practised by boys when at school, but also by many others of both sexes more advanced in years, and consequently capable of distinguishing the small pox from other distempers. There are now living in this town and neighbourhood five or six persons, who undoubtedly had that distemper after taking the foresaid method to infect themselves; one of whom, a young woman aged twenty three, told me lately that about eight or nine years ago in order to infect herself, she held twenty pocky scabs (taken from one towards the latter end of the distemper) in the hollow of her hand a considerable time; that about ten or twelve days afterwards she sickened, and had upwards of thirty large pustules in her face and other parts; and that she has since freely conversed with such as had the small pox on them. A person about six miles off caused his son, about ten years of age, near three weeks ago to buy (as he termed it) the small pox. I have carefully viewed the boy, and find him recovering from the distinct kind of that distemper, not having, as I could perceive, above forty pretty large pustules, just drying off.

To make it appear that inoculation is a sufficient preservative against receiving the small pox a second time; about six weeks ago I caused my two boys, who had been inoculated this last summer, not only to see but even to handle a child dying of a most malignant sort of small pox; who notwithstanding continue in perfect health.

Upon a very exact inquiry I find, that out of 227, who have had the small pox in the natural way in this town and a neighbouring parish since the beginning of June last, 52 have died.

*Of the same
by Mr. R^d
Wright of
Haverford
West. ibid.
p. 267.*

XIII. 4. **I** find buying the small pox to be a common practice, and of very long standing in this country, being assured by persons of unquestionable veracity and of advanced age that they have had the small pox communicated to themselves this way when about sixteen or seventeen years old, they being then very capable of distinguishing that distemper from any other; and that they have parted with the matter contained in the pustules to others, which produced the same effects. There are two large villages in this county near

near the harbour of Milford more famous for this custom than any other, namely St. Ishmael's and Marloes. The old inhabitants of those villages (with which they abound, being in a healthful situation) say, that it has been a common practice with them time out of mind; and what is more remarkable, one William Allen of St. Ishmael's ninety years of age, who died about six months ago or thereabouts, declared to some persons of good sense and integrity that this practice was used all his time; that he very well remembered his mother's telling him that it was a common practice all her time, and that she got the small pox that way. These together with the many other informations I have met with from almost all parts of the country confirm me in the belief of its being a very antient and frequent practice among the common people; and to prove that this method is still continued among us, I will give you the relation of a midwife who accidentally came into company when your letter was reading; her name is Joan Jones aged seventy years, a wowan of good credit and perfect memory. She solemnly declares that having the small pox, about fifty years ago, one Margaret Brown (to the best of her remembrance then about twelve or thirteen years of age) bought them of her; that she was seized with them a few days afterwards; and that she had not had the small pox a second time a twelve-month ago, and she verily believes that she has not had them since. She farther says that she has known this way of procuring the small pox practised from time to time above fifty years; that it has been lately used in her neighbourhood, and that she knows of but one dying of the said distemper, when communicated after the method aforesaid, which accident happened within these two years last past; the person who miscarried (a young woman about twenty years of age) having procured the distemper from a man then dying of a very malignant small pox. The above relation I heard the old woman make two days ago, and she was willing to take her oath of it before a magistrate. As to what you mention concerning the manner of communicating the infectious matter to the blood by scraping the skin thin with a penknife and so rubbing in the matter, that was only the case of one particular gentleman, Mr. Owen, whom I heard several times positively affirm that he bought the small pox when at school, and of such a lady now living, and gave her three pence for the matter contained in twelve pustules. That hundreds in this country have had the small pox this way is certain; and it cannot produce one single instance of their ever having them a second time.

XIV. **T**Here are two propositions advanced by the favourers of inoculation, concerning which the public seems to require more full satisfaction viz. That the distemper raised by inoculation is really the small pox; and, that it is much milder and far less mortal than the natural sort. The former of these is not so much disputed now as when this method was first introduced, nor can it be doubted

Of the inoculation of the small pox, and their mortality in the natural way.
By Dr. Tho. Nettleton to Dr. Jurin n. 374. p. 209. Nov. 1722.

of by any who have seen those that have been inoculated, and hath also been much conversant in the natural small pox. There is usually no difference to be observed betwixt the one sort and the other, when the number of pustules is nearly the same; but in both there are almost infinite degrees of the distemper, according to the difference of that number. All the variation that can be perceived of the ingrafted from the natural is, that in the former the pustules are commonly fewer and all the other symptoms are in the same proportion more favourable. They exactly resemble what we call the distinct sort: the symptoms before the eruption are the very same, and when the pustules rise their appearance is the same, as well as their periods of maturation and declension; they are at first of the same florid, rosy colour, and when fully ripe of as fair a yellow. They commonly rise as round and as large as the other, and when they are very numerous the inflammation and swelling of the face comes on at the usual time and is followed by the swelling of the hands and feet; and only once I observed a salivation though the pustules were distinct. In the natural small pox, when the pustules are very few, we sometimes observe they do not rise to so great a bulk, neither do they ripen so fully nor continue so long as usual; and it is the same in the way of inoculation. In short, as this distemper is raised by an ingraftment from the small pox, as it has the very same appearance, and as it is capable of producing the same by infection, there seems to be no room to doubt of its being the true and genuine small pox. And if that be allowed it will follow that those who have been inoculated are in no more danger of having the distemper again than those who have had it in the ordinary way. And this is also confirmed by experience. We are very ready to own that the operation may sometimes fail: both the gentlemen who first communicated to the Royal Society † some account of this practice from Turkey intimated so much; though I believe that will but rarely happen. In one instance here* I observed no eruption at all, neither did the wounds inflame and swell any more than in a common incision; which made me conclude that what was applied had not taken effect, and indeed the reason of it was evident. In three others, though the wounds did inflame, swell, and discharge considerably, yet the eruptions were so imperfect as to leave me a little in doubt; but two of these have since been sufficiently tried by being constantly with those who had the small pox without receiving any infection. As to all the rest, neither I nor any body else who saw them did in the least question but that they had the true small pox.

† Vol. V. P. I.
C. VI. §. xvii.
1. 2.
* Vid. supra
§. xii. 2.

As to the latter proposition, That the ingrafted small pox is far less dangerous than the natural: the truth of it can only be found by making a comparison, so far as our experience will extend. In order to this I have taken an account in this town and some part of the country, and have procured the same from several other towns here-
abouts

abouts where the small pox has been epidemical this last year, with as much exactness as was possible, how many have had the small pox and how many of them have died.

	Have had the small pox.	Died.
In Halifax	276	43
In a part of the parish of Halifax, stretching towards Bradford	297	59
In another part of the same parish	268	28
In Bradford	129	36
In Leeds	792	189
In Wakefield	418	57
In Rochdale	177	38
In Ashton under Line, a small market-town in Lancashire, including two neighbouring villages	279	56
In Macclesfield	302	37
In Stockport	287	73
In Hatherfield	180	20
Total	3405	636

I am very sensible you will require a great number of observations before you can draw any certain conclusions. I would only remark, that it appears from these accounts that this last year in this part of the kingdom almost nineteen out of every hundred, or near one fifth of those who have had the natural small pox have died; whereas out of sixty one which have been inoculated hereabouts not one has died; for as to the case of Mr. John Sympson's daughter †, which would † Vid. supra have made the sixty second, I leave it out of the account, and I will § xii. 2. refer it to any impartial judgment whether I may not justly do so.

XV. **T**HE number of persons who have had the small pox by inoculation here in England is, by the best information I have been able to collect, as follows.

Inoculated by	<i>A comparison between the danger of the natural and inoculated small pox. By Dr. J. Jurin to Dr. Caleb Coteworth. n. 374 p. 213. Nov. &c. 1722.</i>
Dr. Nettleton	61
Claud. Amyand Esq; serjeant surgeon	17
Mr. Maitland, surgeon	57
Mr. Dover	4
Mr. Weymish, surgeon	3
The Rev. Mr. Johnson	3
Dr. Brady, at Portsmouth	4
Mr. Smith, surgeon, and Mr. Dymmer, apothecary, at Chichester	13
Mr. Waller, apothecary at Gosport	3
A woman at Leicester	8
Dr. Williams at Haverford West	6
Two other persons near the same place	2
Dr. French, at Bristol	1
In all	182
	Out

Out of this number the opposers of inoculation affirm that two persons died of the inoculated small pox; the favourers of this practice maintain that their death was occasioned by other causes. If to avoid dispute these two be allowed to have died of inoculation, we must estimate the hazard of dying of the inoculated small pox, as far as can be collected from our own experience, to be that of two out of a hundred and eighty two, or one out of ninety one.

The Rev. Mr. Mather, in a letter dated March 10. 1721. from Boston in N. England, gives an account that of near three hundred inoculated there five or six died upon it or after it, but from other diseases and accidents, chiefly from having taken the infection in the common way by inspiration before it could be given them in this way of transplantation.

If, as before, to avoid all occasion of dispute we allow five out of these three hundred to have died of the small pox by inoculation, notwithstanding what Mr. Mather has said of their dying by other accidents or diseases; the hazard of inoculation will thence be determined to be that of one in about sixty. But here it must be observed, that by all the accounts from N. England the operators there appear not to have been so cautious in the choice of their subjects as here in England. For Mr. Mather tells us that the persons inoculated were young and old, from one year to seventy, weak and strong; and by other relations we are informed that women with child and others even in childbed † underwent the operation. Apparently the greatness of the danger they were in from the infection in the natural way, which then raged among them with the utmost fury, made them the more adventurous.

† Vid. supra
§ xii. 1.

We come now to the second part of our design, which is to form an estimate of the hazard which all mankind, one with another, are under of dying of the natural small pox, that by comparing this with the hazard of inoculation the public may be enabled to form a judgment, whether or no the practice of inoculation tends to the preservation of mankind by lessening the danger to which they are otherwise liable. With this view I have consulted the yearly bills of mortality as far back as 1667, being the year after the plague and the fire of London, comprehending to the present time the space of fifty six years, from forty two of which I have given extracts in the two following Tables. The first takes in the first twenty years, distinguishing for every year the total number of burials, and likewise the number that died of the small pox, in two separate columns. The third column shews how many died of the small pox out of every thousand that were buried; and the fourth column represents the proportion between those that died of the small pox and the whole number of burials, by the nearest vulgar fraction having always one for the numerator. The second table gives the last twenty two years after the same manner; and at the bottom of each table is given the total number

number for each series of years, and likewise the number that died each year taken at a medium one year with another: by which it appears that the proportion between the number of those that die of the small pox and the whole number of burials is very nearly the same upon an average for each series of years. The fourteen intermediate years between 1686 and 1701 are left out, because in the bills for those years the accounts of the small pox and measles are not distinguished, as in the preceding and following years, but are joined together in one article, so that from them no certain account can be drawn of the number of persons that died of the small pox.

TABLE I.

TABLE II.

Died of the small pox.				Died of the small pox.			
Total No Years of Burials	In all.	In 1000	In proportion	Total No Years of burials	In all	In 1000	In proportion
1667 15842	1196	75	$\frac{1}{33}$	1701 20471	1095	53	$\frac{1}{19}$
1668 17278	1987	115	$\frac{1}{9}$	1702 19481	311	16	$\frac{1}{62}$
1669 19432	951	49	$\frac{1}{25}$	1703 20720	898	43	$\frac{1}{47}$
1670 20198	1465	73	$\frac{1}{27}$	1704 22684	1501	66	$\frac{1}{34}$
1671 15729	696	44	$\frac{1}{35}$	1705 22097	1095	50	$\frac{1}{44}$
1672 18230	1116	61	$\frac{1}{29}$	1706 19847	721	36	$\frac{1}{55}$
1673 17504	853	49	$\frac{1}{34}$	1707 21600	1078	50	$\frac{1}{43}$
1674 21201	2507	118	$\frac{1}{18}$	1708 21291	1687	79	$\frac{1}{27}$
1675 17244	997	58	$\frac{1}{29}$	1709 21800	1024	47	$\frac{1}{46}$
1676 18732	359	19	$\frac{1}{92}$	1710 24620	3138	127	$\frac{1}{19}$
1677 19067	1678	88	$\frac{1}{22}$	1711 19833	915	46	$\frac{1}{43}$
1678 20678	1798	87	$\frac{1}{24}$	1712 21198	1943	92	$\frac{1}{23}$
1679 21730	1967	91	$\frac{1}{24}$	1713 21057	1614	77	$\frac{1}{27}$
1680 21053	689	33	$\frac{1}{64}$	1714 26569	2810	106	$\frac{1}{25}$
1681 23971	2982	125	$\frac{1}{19}$	1715 22232	1057	48	$\frac{1}{46}$
1682 20691	1408	68	$\frac{1}{30}$	1716 24436	2427	99	$\frac{1}{25}$
1683 20587	2096	102	$\frac{1}{20}$	1717 23446	2211	94	$\frac{1}{25}$
1684 23202	156	7	$\frac{1}{34}$	1718 26523	1884	71	$\frac{1}{37}$
1685 23222	2496	107	$\frac{1}{22}$	1719 28347	3229	114	$\frac{1}{25}$
1686 22609	1062	47	$\frac{1}{47}$	1720 25454	1440	57	$\frac{1}{45}$
20 Years 398200	28459	71½	$\frac{1}{55}$	1721 26142	2375	91	$\frac{1}{29}$
				1722 25750	2167	84	$\frac{1}{31}$
				22 Years 505598	36620	72	$\frac{1}{70}$
Each year at a me- dium. } 19910	1423	71½	$\frac{1}{14}$	Each year at a me- dium. } 22982	1665	72	$\frac{1}{31}$
				42 years 903798	65079	72	$\frac{1}{125}$
				Each year in 42 at a medi- um. } 21519	1550	72	$\frac{1}{14}$

By these tables it appears that upwards of seven per cent. or somewhat more than a fourteenth part of mankind die of the small pox; and consequently the hazard of dying of that distemper to every individual born into the world is at least that of one in fourteen. And that this hazard encreases after the birth as the child advances in age will appear from what follows. From this estimate it is demonstrable that in the case of persons actually having the small pox the hazard they run, one with another, of dying of that distemper is greater than that of one in fourteen; or, which is the same thing, there must be fewer than thirteen that recover, for one that dies of the small pox. For since one fourteenth part of mankind die of the small pox, and the other thirteen parts die of other diseases; if these thirteen have all had the small pox and recovered from it before they fell ill of those other diseases of which they died, then just thirteen will have recovered from the small pox for one that dies of that distemper: but as it is notorious that great numbers, especially of young children, die of other diseases without ever having the small pox, it is plain that fewer than thirteen must recover from this distemper for one that dies of it.

To determine exactly how many of these thirteen parts of mankind die without having the small pox is a very difficult task; but it is easy to see that a considerable deduction is to be made from them. In the first place, the two articles of stillborn and abortive children, which are put into the yearly bills as part of the number of burials, are unquestionably to be deducted. To these two we may add the following heads, which, by the best information I can procure comprehend only very young children, or at most not above one or two years of age. Overlaid, chrysoms and infants, convulsions, horse-shoehead, headmoldshot, teeth, water in the head, worms, rickets, livergrown, chin-cough and whooping-cough, which articles in the yearly bills for twenty two years last past amount at a medium to 386 in each 1000 of the whole number of burials.

It is true indeed that, in all probability, some small part of these must have gone through the small pox, and therefore ought not to be deducted out of the account: but then, on the other hand, as it is

certain, that of the remaining $\frac{614}{1000}$ of mankind, that are above one or two years of age, there are great numbers that never have the small pox, it will I presume be judged no unequal supposition that all contained under the heads abovementioned have mis'd that distemper, when by way of compensation I allow all the remainder of mankind to undergo it; which concession is so large that it will abundantly make up for what I assume too much in the former supposition. Allowing therefore that out of every thousand children that are born three hundred and eighty six die under one or two years of age without having the small pox, and seventy two do some time or other die

of that distemper; it follows that the hazard of dying of it, to the remainder of mankind above one or two years of age, who are all supposed to undergo that disease sooner or later, is that of seventy two out of six hundred and fourteen, or nearly two out of seventeen: so that no more than between seven and eight can recover from that distemper for one that dies of it. And if any considerable part of the ^{afore}said remainder of mankind, more than is allowed for above, do escape having the small pox, then the proportion of those that recover from it will be still smaller.

This consideration shews the fallacy of one plausible argument that has been often made use of against inoculation: which is, that whatever be the danger of dying of the small pox to those that actually have that disease, yet as great numbers of persons never have the small pox at all this danger is what any particular person may never be in; and therefore it will be madness to undergo the hazard of inoculation be it great or small, in order to prevent a disease which possibly may never befall one. For if two parts in seventeen of all mankind, that are above one or two years of age, must sooner or later die of the small pox, it is plain that how many parts soever of these seventeen are supposed to escape that distemper, the mortality among the remainder who undergo it must in proportion be so much the greater. As for instance, if seven parts escape having the small pox and ten undergo it, then two out of ten, or one out of five that have the small pox must die of it. And as it can never be known whether or no any particular person be one of those that are to have the small pox; his hazard of dying of it being made up of the hazard of having it and the hazard of dying of it if he has it, will be exactly the same, namely that of two in seventeen, or one in eight or nine, whether the proportion of mankind that escape having the small pox be great or small.

But as what has been said concerning the hazard of the natural small pox is taken from an account of forty two years; whereas the hazard of inoculation is estimated only from what has happened in the space of about eighteen months since which time it had its first rise among us; it will perhaps be asked by some persons, why we do not likewise make the estimate of the hazard of the natural small pox from the last two years alone, without running back into so great a number of years before inoculation was begun? To which we answer, that the proportion of those who die of the small pox varies so much in different years, as appears from the tables above, that it was impossible to come at any certainty in this point from the consideration of the two last years alone: and if any one suspects us of partiality in proceeding after the manner we have done, he need only cast his eyes upon the second table, where he will find that the mortality of the natural small pox for the two last years has considerably exceeded the medium we have determined from taking in two and forty years.

There

† Vid. *supra*
§ xiv.

There is another method which, if it were put in practice in several large towns or parishes and for a sufficient number of years, would enable us to come at a nearer and still more certain computation of the proportion between those that recover and those that die of the small pox: which is, to send a careful person once a year from house to house to enquire what persons have had the small pox and how many have died of it in the preceding year. This has been done by Dr. Nettleton the last year at several towns in Yorkshire, &c. † and the same was done at Chichester for the same year to the 15th of October last by a person of credit. Such another account has been transmitted to me from Haverford West in South Wales by Dr. Perrot Williams. The sum of these accounts is as follows.

	Sick of the small pox.	Died.
Several towns in Yorkshire	3405	636
Chichester	994	168
Haverford West	227	52
Total	4626	856

From which it appears that, upon a medium between these accounts, there died of the small pox almost 19 per cent. or nearly one in five, of persons of all ages that underwent that distemper. Which is the more to be remarked for that out of eighty two persons that had the small pox by inoculation the same year, and in the neighbourhood of the same places, not one miscarried. Mr. Mather observes in his letter mentioned above that out of more than five thousand persons that had the small pox at Boston in N. England, within little more than half a year, near nine hundred died, which is more than one in six; and this account added to those from Yorkshire, Chichester and Wales, reduces the proportion of those that die of the small pox to somewhat more than 18 per cent. so that the hazard of dying of that distemper, to those who are taken ill of it, is that of one in between five and six, or something above two in eleven.

The result therefore of these computations is, that if the same proportions should still continue as have hitherto been determined by observation we must expect,

That of all the children that are born there will, some time or other, die of the small pox one in fourteen.

That of persons of all ages taken ill of the natural small pox there will die of it one in five or six, or two in eleven.

That of persons of all ages inoculated, without regard to the healthiness or unhealthiness of the subject as was practised in New England, there will die one in sixty.

That of persons inoculated with the same caution in the choice of the subjects as has been used by the several operators in England (if we allow in the two disputed cases abovementioned, that the persons died of the inoculated small pox) there will die one in ninety one.

But

But if those two persons be allowed to have died of other accidents or diseases, then we shall have reason to think, as far as any judgment can be made from our experience here in England, that none at all will die of inoculation provided that proper caution be used; as we are informed on all hands, is the case in Turkey; where out of many thousands that, in the space of about forty years past, have been inoculated in and about Constantinople by one Greek woman, who still continues that practice notwithstanding her extreme old age, not so much as one person has miscarried, as I am assured by the ingenious Dr. le Duc a native of Constantinople, who was himself inoculated there under the care of his father an eminent physician in that city.

XVI. 1. **T**HE following account of the success of inoculation in and about Boston in New England confirms the extract given above from Mr. Mather's relation, and is a more particular account of the matter of fact than any that I have yet seen.

The success of inoculation at Boston in N. England. By Capt. J. Osborne. Communicated by Dr. Jurin. n. 374. p. 225. Nov. 1722.

In May 1721. the small pox was brought into the town of Boston; in June it began to spread pretty much, and in the month of July it was got into most parts of the town, and a considerable number of people died of it. At this time inoculation was first put in practice by Dr. Boylston, who then performed it upon his own child and a negro-servant, who both did well; notwithstanding which this attempt gave great uneasiness to the neighbours. However the practice went on to the number of about forty persons, one of whom was a woman of about forty or forty five years of age, who got well over the small pox, as her husband publicly declared, but had been before troubled with hysteric fits, of which she died some little time after. When about seventy persons had passed under the operation, myself and wife, who had hitherto been at a place called Roxbury a mile from Boston, went into town and received the small pox by inoculation. We had it with all the gentleness that was possible, neither of us having an hundred pustules or being sensible of any fever worth mentioning; so that we did not find it necessary to keep our beds for it. In August the small pox in the natural way proved more mortal, and inoculation made a greater progress, the people continuing to come into the practice of it. A second person that died after inoculation was an apothecary's housekeeper, who staid out of town till an Indian maid got the distemper in the same house, and removed, and died. Upon which this woman coming to town, her master undertook to perform the operation upon her, which by the way was the first and last that he ever performed; and on the third day after the inoculation the small pox came out upon her very full; from which it was plain that she had taken the infection before in the common way. The third person that died after being inoculated was a gentleman that lodged in the same house with my wife and me at Roxbury, who was under extreme infirmity of body, as I was witness, so that we feared he would have lived but a short time under it.

His friends much persuaded him to make use of inoculation, believing that it would have carried off his illness; but when he made the experiment he had not strength to go through with it. He was about forty five years of age. His sister was the fourth person that died upon this operation. She was about forty years of age, of great indisposition of body, and weak as her brother. The fifth that died upon inoculation was a woman servant in a house where the whole family, to the number of eight, were inoculated at the same time. She lay in a cold upper room during her illness and was much neglected, the whole family being down together, so that she died merely for want of a little attendance. This was in the town of Roxbury, where observe that thirteen men, masters of families, got the small pox and all died; which inclined the people to make use of inoculation, having before been much against it, and there were forty three men inoculated there who all did well. The minister of the town was the first that put it in practice there, much against the mind of his people at first, though afterwards they were very well pleased with it, seeing with what great success it was attended; and then whole families underwent the operation. There were in all at least two hundred and eighty persons inoculated that I knew of, and I suppose there might be about twenty or thirty more, but of those I can give no certain account.

At Salem in New England. By Mr. Tho. Robie. n. 382. p. 67. March &c. 1724.

XVI. 2. **W**E don't as yet see any ill effects of inoculation, but those who have been inoculated are as well, and some of them a great deal better than ever. As to the ill consequences of it in England, I can hardly think they are the genuine effects of inoculation, but may arise from some previous ill disposition or for want of due evacuations after inoculation, and healing up the places of incision too soon.

A remarkable instance of the infection of the small pox. By Dr. Jurin. n. 373. p. 191. Sept. &c. 1722.

XVII. **A** young gentleman ill of that sort of the small pox which is called the coherent, or the middle between the distinct and the confluent kind, on the 3d Oct. 1722, being the sixth day from the eruption, grew delirious in the night and got out of bed in spite of the opposition of two nurses that attended him; and seizing one of them by the neck with his bare arms, he pressed her forehead against his naked breast then covered with the small pox in the state of maturation, and held her for some time in that posture. She was heated by striving with him and in struggling to get loose, and was sensible that she broke some of the pustules with her forehead. The woman was about forty years old, of a clear, florid, sanguine complexion; she told me she had had the small pox when she was about seven or eight years of age and had been pretty full of them, but I saw no marks upon her face. October 5. in the morning the small pox began to appear upon her forehead and increased by degrees to between fifty and sixty; she had likewise a small number of pustules upon the back part and sides of her neck where the gentleman

man had grasped her with his naked arms ; but had none, as she told me, upon any other part of her body. The lower part of her face was perfectly clear, and those upon her forehead were chiefly confined to the middle and most prominent part of it which had been press'd against the gentleman's breast. They rose gradually and came to maturity in the same manner as the small pox of the milder coherent kind use to do, with a great inflammation and swelling of her forehead and the adjoining part of her face, especially between the eye-brows where a small cluster of the pustules were seated, insomuch that on the ninth of October her right eye was quite closed up and the left almost in the same condition ; but all this time she had no fever, sickness, or other symptom of the small pox beside this eruption and the inflammation and pain that attended it. That night she caused a blister to be applied to her neck, upon which she recovered the sight of her eye the next day being the sixth from the eruption, when the pustules were turning and beginning to scab. The scabs agreed with those of the milder coherent small pox in their appearance and duration. I saw her hitherto every day, as likewise at several times after this, and particularly on Oct. 22d which was the eighteenth day from the eruption of the pustules, when she had still some small part of the scabs remaining upon her forehead.

In this instance it is worthy of remark : 1st, that this woman, though she had had the small pox before, was yet infected again by the immediate and close application of the variolous matter to her skin when her body was heated with exercise. Which seems to prove, that such an application is more effectual to give the infection than the bare morbid effluvia arising from the body of the sick person and received into the sound one by inspiration ; for that she received no infection by inspiration is plain from the appearing of the small pox upon those parts only where there had been such an application and contact. From which it seems very probable that a person who has already had the small pox, as the man inoculated by Mr. Tanner in St. Thomas's hospital, may possibly receive it again in some slight degree by inoculation ; that being still a more close and immediate application of the variolous matter to the blood and juices of the sound person, than when it is applied only by contact to the skin whole and unwounded. 2dly, that the infection communicated to this woman not being universal, as appears from her having no fever, or sickness, or general eruption of the pustules all over her body, but only on the parts infected by immediate contact, no argument can be drawn from hence for a person's being liable to undergo the small pox a second time, so as to have the usual symptoms of that disease and a general eruption of the pustules ; but rather the contrary. 3dly, that the time in which this infection shewed itself by the appearance of the pustules is very different from that observed upon

T 2

* Vid. supra
§ xii. 2.

Of the anomalous epidemic small-pox at Plymouth from August 1724 to June 1725. By Dr. Huxham. n. 390. p. 379. Sept. 1725.

inoculation; the first appearing in about a day and a half; whereas in the latter case the eruption generally shews itself on the tenth day, or not above a day sooner or later, as appears from Dr. Nettleton's accurate observations*. Which difference is what ought in reason to be expected, since in one case the infection went no further than the parts affected by immediate contact; whereas in the other it must be propagated through the mass of blood to all parts of the body.

XVIII. **T**HE small pox were preceded by the usual symptoms of that distemper; but the pains of the limbs and back were generally more severe than common, as were likewise the nausea and vomiting. Abundance were seized with violent cholic pains which would leave them upon the eruption, or after a clyster or two with a gentle anodyne: the stools were commonly bilious. It sometimes happened that the symptoms would not seem very severe before and at the eruption; and yet the pox would prove very confluent and fatal at the state. The pustules were very small and did not regularly fill; but in a day or two after the eruption would flat and be depress'd in the middle. I observed this even in the distinct kind. In some persons they appeared in less than twenty four hours from the seizure: when they broke out so very soon they were always of the flux kind, as is commonly observed. The eruption was attended with prodigious sneezing, especially in children. I saw one child about five years old that sneezed incessantly for more than thirty hours, nor could it be allayed but by anodynes. This child had the confluent pox and died the thirteenth day. In some, at and after the appearance of the pustules, they would itch most intolerably: this happened also to the child now mentioned, and was generally a bad symptom; as it was an argument of the great acrimony of the morbid matter. In some few a day or two after the eruption seemed to be compleated there would appear in the interstices of the pox several miliary pustules, some of a dark red, others filled with a limpid serum: these never came to suppuration, as the secondary crop of small pox, which I have now and then observed, sometimes do; nor were they as large. Though this is an ill symptom in general, yet in a girl of seven years old I perceived the fever and delirium go totally off upon this eruption, and the urine immediately settled. Some had abundance of purple petechiæ appear among the pox at the eruption, and the pustules would look of a lurid hue: In others the purples would not discover themselves till the maturation. I knew but one person that had these spots during this constitution that survived the distemper; but some died the fifth or sixth day, some dwindled on till the tenth or eleventh. During the suppuration the pox would become very sessile, and the coherent kind would enlarge their bases exceedingly; so that though they seemed for some time after the eruption to be very distinct they would now flux together. A purple speck

speck would often appear in the center of the pustules, which would spread and grow blacker and blacker by degrees. The interstices would also sometimes turn pale, sometimes livid: symptoms of very ill omen. The pustules that had not the purple speck did not incrust yellow, but appeared of a dead, ash colour, and by degrees grew into a dark black crust. The salivation, which constantly ought to accompany the maturation in the confluent small pox, was in several very inconsiderable, in some none at all, saving a very small quantity of extremely viscid matter which was got off by syringing. I had two adult persons and some children labouring under the confluent sort, who neither salivated nor purged, except when some lenient cathartics were given them; and yet they got over the distemper. Indeed it was very rare that we should find children have that gentle diarrhoea which Sydenham and others justly reckon supplies the salivation in persons of more advanced age. Some very young children, on the contrary, drivelled exceedingly through the course of the distemper. In two children, one of five the other of seven years old, no salivation came on till after the thirteenth day, and then it was so profuse and continued so long that it was with difficulty I put a stop to it by purges first and then by the bark, astringents, &c. To the younger of these, indeed, I had given calomel gr. iv. but it was soon purged off. Where the swelling of the face and throat was very hard, painful and tense, with a strong vibration of the carotid arteries, and little or no salivation, the patients generally grew delirious at the state. These symptoms frequently proved fatal. The maxillary and parotid glands of those that recovered would remain swollen and indurated for a considerable time after the entire desquamation of the pox (though that was very slow) nor would these tumours go off but after repeated purging and that with calomel, &c. These tumours were undoubtedly the consequence of a very viscid matter obstructing the glands, which hardened the swelling of the face, hindered the salivation, and in some measure the circulation through the external carotids; by which means more blood being forced through the internal, an inflammation of the brain and a delirium might be partly brought on; and this happening too when the blood was fraught with acrimonious matter absorb'd from the pustules, rendered the delirium at that stadium of the disease vastly more to be dreaded than in the apparatus when it happened almost of course. Under these circumstances, bleeding, emollient clysters, eccoprotics and plentiful dilution, were absolutely necessary,

On this occasion it may be asked whether or no, the salivation being very viscid and defective the tumour of the face hard and tense, some mercurial (as a duly prepared calomel) might not be given with advantage even in the state of maturation? (I have frequently given cinnabar to good purpose.) There are some instances that would seem to justify such a practice; and I know but one material objection

tion to it, and that is, that the weight of the mercury would by encreasing the moment of the blood augment the fever; but surely we have given calomel after the incrustation, when the secondary fever hath subsisted, without any manner of ill consequence, I might say with great success. Nothing so certainly fufeth viscous tough humours as this joined with plentiful diluting liquors, and so prepares them to be discharged by proper outlets. As to oxymel scillit. syringing, and the like, in a defective salivation; the former indeed by puking sometimes irritates the glands of the membrana Schneideriana to discharge their contents; syringing barely deterges the mouths of the ductus salivares: either have little certain effect further; whereas the viscous obstructing matter is lodged in the inmost glands and even in the blood itself. This method seems peculiarly adapted to such an epidemic small pox as I am now describing, in which we had all the indications imaginable of a very viscid state of humours. The blood when drawn was always excessively viscous, especially at the state of the disease: frequently there was little or no salivation; generally it was extremely glutinous; so that the nurses were many times obliged to pull the matter out of the patient's mouth with their fingers; and without drinking very plentifully it would soon cease. A diarrhoea very seldom happened to children. The blisters soon dried up. I heard of no one during this constitution that made bloody urine. Where that dreadful symptom happens the crisis of the blood seems to be dissolved, as Lyster well observes; on the contrary, the recited symptoms argued a too compact and viscous diathesis of the blood.

This state of the humours during this constitution might, in part at least, depend on the extraordinary driness of the season, and the almost constant northerly and easterly winds, which we had in the months of Oct. Nov. Feb. and March last. From the middle of Jan. to the middle of April was a drier season than ever was known in this country, where we have certainly, in general, more continued rain than in most places in England, Plymouth being infamous for wet weather. This remarkable change of the temperature of the air must undoubtedly have some considerable effect on human bodies: a very cold wind suffering only the thinner part of the blood to pass off by perspiration: nor in such seasons doth the body imbibe so much of a diluting humidity from the air, as Keil observes. Hence the necessity of drinking plentifully of thin diluting liquors, which, as it is always proper in this distemper, so when it happens in such a season is highly necessarily. And I am of opinion M. Andry's method of bathing in warm water and milk, or warm milk, before the eruption may, upon many accounts, be proper in such a constitution of the air. There can be no objection against it but its not being in fashion. I took particular notice that while, and just after, the easterly winds blew excessively strong for seven or eight days together in the months of Oct. and Nov. the patients I then saw in the small

pox scarce salivated at all. Then particularly an adult person who had the confluent pox very severely did not spit the least through the whole course of the disease; she was seized with a violent pleurisy the eighteenth day, but was relieved by bleeding. The blood was the most viscid that ever I saw. It is remarked by Lancisi that people expectorate very little in disorders of the breast, when cold, dry, easterly winds blow; and it is what I have frequently observed: and this may be one reason why some asthmatics generally suffer a paroxysm at such seasons.

The swelling of the hands did not so regularly succeed the detumescence of the face, during this constitution, as I have observed in other epidemic small pox. Some had very small, or rather no tumours at all. It was very rare the legs and feet swelled till after the patients sat up, and then they had much pain in those parts. I have often reflected whether the succession of the tumours of the hands to that of the face might not partly depend on the latter inflammation and suppuration of the pustules of those parts: the pain and inflammation being a stimulus determining the humours to the pained part: and it is particularly to be observed that the greatest pain of the hands and arms commonly happens at the time when the salivation begins to cease: so that the tumour of the hands may in some measure prove a succedaneum to the spitting. It is the common observation that the pustules of the arms and hands inflame and mature a day or two later than those of the face, and those of the legs and feet latest, which may also be the reason that the tumour of the legs succeeds that of the hands. I have been the rather inclined to this opinion, because I have sometimes observed a considerable swelling of the hands (the pustules being very painful and inflamed) and that too in the distinct kind, when there hath been little or none in the face. Generally the more painful a boil is, the greater the tumour around it; and by consequence the tumour of a part is in proportion to the painfulness of the boils and their number. From this I would enforce the use of epispastics applied above the wrists, a little before the time we expect the tumour of the hands should arise (especially when symptoms are threatening) as they are stimuli to be depended on, not only attenuating and deriving the humours to the parts but also discharging them, and so proving a convenient outlet to the morbid matter, which before was thrown off by the (now partly suppressed) salivation. Blisters applied to the neck frequently relieve the extreme pain of the throat and difficulty of swallowing, which are sometimes exceeding troublesome to the patient in the third stadium of the small pox, by drawing the humours another way. Nay, in some, where vesicatories have been early applied and continued to run extreamly, there hath been less swelling and less salivation, than seemed proportionate to the vehemence of the distemper, but without any disadvantage to the patients; the running of the blister supplying the defect of

of the spitting. It seems then but reasonable when we expect the translation of the noxious humour to the hands, which is what nature itself affects, to endeavour to promote its flux thither and give it vent. How advantageous discharges of this nature may be I had occasion some years since to observe in the case of a lady for whom I was concerned together with Dr. Seymour of this town; where, through the prodigious discharge of blisters applied to her neck, ears, and arms, as likewise a plentiful flux of urine, she neither swelled nor salivated through the whole course of a very dangerous, confluent small pox, and yet recovered. Any person that hath been conversant in practice cannot but have observed translations of the morbid matter from one part to another sometimes of the greatest service, especially where it hath had a discharge. Indeed all critical evacuations are of this nature. But I mean, how often hath a boil, an imposthume, or swelling of the limbs, been the evident means of terminating a fever? this I experienced particularly in myself several years since at Paris; when labouring under a violent, inflammatory fever with delirium, the ninth day towards night I was seized with excessive pain in my arms and hands, upon which I bathed my hands a long time in warm water by persuasion of two worthy gentlemen of the faculty now living, who were then my fellow students and watched by me. In a little time my hands began to swell, and in four or five hours my delirium and fever went off intirely, though my hands remained swoln and pain'd for some time. If nature, therefore, in some cases take such extraordinary methods to free herself from diseases, how intent ought we to be in promoting her operations, in a distemper where the metastasis of the morbid matter to the hands and feet is generally regular and salutary. 'Tis undoubtedly upon this view that Baglivi orders sponges soaked in a warm emollient decoction to be applied to the hands and feet in the small pox: and this, he saith, he hath done with great success. I have seen no less from blisters maturely applied to the arms and legs; but then I ordered the patients to drink plentifully of a thin whey, or the like, which takes off in great measure the acrimony of the cantharides. Before I conclude this paragraph I cannot but observe that the delirium attending the eruption of the small pox is very much alleviated by the application of emollient cataplasms to the feet, in children especially. It is indeed what I commonly of course of apply, when I am consulted at the beginning of the distemper, and I think I have had reason to imagine, in many cases, that it hath been a means of deriving the variolous matter that way; and by making the eruptions more copious in the lower parts the face and breast have suffered less than I had reason to fear otherwise might have happened. The great tenderness of the feet after their application is a trifling disadvantage, in comparison of the benefit that may be received by them; and so are those shooting pains which often affect the legs on the use of those cataplasms: not

to say that these are rather than an argument of the benefit arising from their use.

In the confluent kind generally a micturition and dysury came on about the twelfth or thirteenth day; and that when there were no blisters applied. If a large quantity of turbid urine followed, it was soon succeeded by urine which deposed a very large sediment; but if it proved thin, limpid, and in small quantity a delirium, tremor, subsultus tendinum, and other convulsive symptoms soon followed. There were no symptoms so certainly fatal at the turn of these small pox as a delirium, and (what is, I think, of constant ill omen in all kinds of eruptive fevers at the state) a dyspnœa or the anhelosa respiratio: if we bled upon the first appearance of them we frequently saved our patient; the omission of which a few hours made the case irrecoverable.

It was very common in persons afflicted with these pox that eight or ten pustules would run together, and form a large vesication full of a limpid, crude matter, which would continue so several days after the incrustation. In one that died I saw mortifications under these bladders. I thought it necessary to let out this matter with a lancet or needle as soon as possible, lest it should (as it did when left to itself) cause an ulceration; and I could not but believe it proper inasmuch as the thinness of the matter rendered it capable of being absorbed into the mass of blood, and that the longer it lay the more acrimonious it would grow, it not admitting of concoction. In two patients I saw several of the pustules filled with a bloody sanies: I was surprised to find one of them get so easily over the distemper, though she laboured also under the flux kind.

The desquamation was very slow, the black crusts adhering several days, nay weeks, after the turn, while abundance of purulent matter gleeted from under them. These left very ugly cicatrices. No application seemed to me to have a better effect in this case than frequently fomenting the parts with warm milk, or milk and water; this diluted the acrid salts, washed them off, and softened the skin: oily liniments by stopping the pores are frequently hurtful.

In a case or two I observed a repullulation of pustules under the crusts in the face and hands when thrown off; particularly in the boy that recovered with purple spots. The latter were distinct, though the former were in the greatest degree confluent.

Nothing so certainly abated and took off the secondary fever after bleeding (if indicated) as gentle cathartics; such as rhubarb, manna, tartar, infus. senn. and the like. The hot, scammoniate, aloetic purgers seem not so proper, at least to begin with. These I gave the tenth, eleventh, twelfth, or thirteenth day, if I found the patient have a quick pulse, feverish heat, dry tongue, head-ach, restless anxiety, and other symptoms of the putrid fever. Some one or other of these being once or twice repeated, I gave calomel and purged it off. This

was our general method and the most successful. I cannot but think the world highly obliged to the learned Dr. Freind and the other noble ornaments of our faculty that have introduced and wrote in favour of this method. In the beginning of my practice, relying upon the authority of Morton, I gave the cortex to check the secondary fever; especially when I found it (as is very frequent) evidently intermit; but I cannot say with a success any way answering my expectation: not but that after due purging the bark is very proper to extinguish the hectic disposition of the blood, which is frequently the consequence of the small pox, to which if a cool regimen and asses milk (where no idiosyncrasy forbids it) be subjoined, we have done perhaps as much as lies in the power of physic. By this method of early purging in the coherent and confluent pox I have seen several rescued from the most imminent danger, whose recovery looked rather like a resurrection. This surely is the only way of cleansing the primæ viæ stuffed with a load of foetid, acrid impurities thrown off by the glands of the guts, which cannot be suppos'd to cease from their office during the course of this distemper: and as the pores of the skin are at this time very much constipated by the incruusted pustules, it is reasonable to believe the glands of the guts rather separate more than usual; it being an allowed maxim in physic, that the lessening one evacuation is the encrease of another; especially where there is such a peculiar consent as between the skin and the guts. If so, the excrement being retained for a week, or more, and by its weight pressing on the great artery hinders the blood from passing freely to the lower parts and so deluges the brain. Hence those deliriums, coma's, &c. so frequently threatening at this stadium of the disease. Further, can we imagine that the putrid recement of the now putrid blood, joined perhaps with the pus of the internal pox, and having also the addition of some part of the morbid matter separated by the glands of the fauces which is accidentally swallowed, must not be greatly hurtful by remaining in the intestines? where growing more and more acrimonious (as is the nature even of our most balsamic juices when they are extra-vascular circulationis and exposed to the constant heat of the body) it contaminates the chyle, or liquors that are drunk, is re-absorbed into the mass of blood, and becomes a pabulum to the very fever which nature endeavours even this way, partly at least, to throw off. And indeed what horribly offensive, foetid, large stools do we observe in this distemper on the use of clysters, and more especially after a purgative? I mean at the state or in the declination: so that this very putrid matter lying long in the guts, and growing more and more so, becomes at last so virulent as to corrode them, and brings on that very diarrhœa or dysentery, which it is so vainly feared would arise from a gentle cathartic; seeing we are always easily able to check its force (if need be) with an opiate, &c. How often do we find feverish, hectic heats proceed from a cacochymy of the first passages, in children

dren especially? in which case a little rhubarb or a few gentle stomachic purgers shall do more to remove the feverish disposition than a pound of the cortex. Indeed it is common enough to find the bark itself purge gently upon its first administration: and I am confident, in some cases, it hath the better effect. Have not we seen some intermittents cured by one seasonable vomit? and that not barely by the shock and agitation given to the blood-vessels, genus nervosum, &c. and so acting as an attenuant; but by throwing off the saburra from the stomach which fed the feverish paroxysms: and this is more particularly evident in the fever frequently supervening a surfeit. Hence it is that a small quantity of the bark sometimes does more after a vomit than a much greater could before it. Why, therefore, when there is a lodgment of putrid matter in the primæ viæ, which, in part at least, feeds the secondary fever, should not we attempt to carry it off by either gentle vomiting or purging as may be judged most convenient?

It hath and may be objected to this practice that it tends to draw the noxious humours from the circumference to the center; but to this it hath been answered that the purging is more especially pleaded for when the incrustation is begun and the matter too thick to be absorb'd. If nature neither by her own effort, nor the help of art, is capable of keeping the morbid matter from falling on the more vital parts; but by an unfortunate translation of it is like to sink under its weight: as upon a sudden retrocession of the tumour of the face and hands; a premature suppression of the salivation, or the like: doth it not seem necessary to endeavour to carry off the offending matter by some other outlet? as, in the present case, by the guts, which are much more easily solicited to a discharge, than either the pores of the skin, the urinary passes, or the salivary ducts. Indeed, when the salivation of course ceases, in my opinion it seems necessary to promote some other evacuation in its room. At the same time, cardiac or alexipharmic medicines are in no wise contraindicated by this method, if judged needful. This way nature affects in children, to whom a gentle diarrhœa is commonly of the greatest service, as proving a happy substitute to the salivation in elder persons.

The following history will evince, how necessary it may be sometimes to evacuate an offending acrimonious matter lodged in the guts, and that too even in the midst of the suppuration. About three months since I had under my care a person about thirty, ill of the small pox. It happened that the fourth day from the eruption he was seized with a violent bilious cholic to which he had been formerly subject: this threw him into the utmost agony. His pox flatted and grew pale, as likewise the interstices: his pulse was extreme languid, and he had a prodigious tremor, with clammy sweats. I ordered him two clysters to be thrown up; one as soon as the other was rendered: these gave him five large bilious stools: after the third stool he was tolerably

rably easy: however I ordered him laudan. solid. gr. iß. croc. anglic. gr. iv. theriac. andromach 3ß. 4^{tis} vel 6^{tis} horis, to be washed down with a testaceous julep. He took the laudan. three times, and slept sound all night. The next morning I found the pustules round, florid and turgid. The man got over the distemper, though he relapsed into his cholic some days after the turn, which upon purging with calomel, &c. and the use of opiates soon left him. This person before and at the eruption complained of a great difficulty of breathing, with a short importunate cough, and a violent pain under his sternum; for which reason I ordered sixteen ounces of blood to be drawn which was very fizy.

The major part of the adult persons that had the unhappiness to be seized with this distemper died; among whom fell an old gentlewoman of seventy two; a very uncommon exit for a person of her years. It was a remarkable instance of the extraordinary virulence of these small pox, that the women (though they had had the small pox before and some very severely too) who constantly attended those ill of the confluent kind, whether children or grown persons, had generally several pustules broke out on their face, hands and breast, exactly resembling the pocky pustules, which undoubtedly arose from the matter of the crushed pox infecting the skin in those parts. Those pustules arose, matured and scabb'd off, intirely like the true pox. I knew one woman that had more than forty on one side of her face and breast; the child she attended frequently leaning on those parts. I observed that those who had the tenderest skins, and who attended those ill of the worst sort, had most of these eruptions. We had abundance of instances of this nature.

In the beginning of this constitution the small pox were much more malignant than they have been for this month or two last past. Indeed when they raged most severely some children had them very favourably, and required no other physic than to be duly purged after them.

*The condition
of the town of
Hastings after
the small pox.
By Mr. Frewen
to Dr. Jurin.
n. 419. p. 108.
June &c.
1731.*

XIX. **T**HE following is a true account of the present condition of the town of Hastings, after its having been visited with the small pox; which continued there about a year and half. I should here insert an account of those inoculated, if any thing remarkable had happened: I can only say this, that they all had the distemper very favourably, and continue perfectly well.

The number of those that recovered of the small pox (including	608
four that were inoculated,	
Died of it	97
Escaped it	206
Died of other illnesses since the small pox raged there	50
The whole number of inhabitants in that town are	1636
	Males 782
	Females 854

N. B. There is at present no small pox in that town.

XX. 1. **B**Efore I engage in the principal design of this letter, which will be to prove that the venereal disease, when it came to be confirmed, was frequently known among us some hundreds of years before the siege of Naples, I shall endeavour to refute the opinion of those who believe it to have had its rise there, if there be any such who have read my former letter in *Phil. Trans.* N^o 357 †. Many have indeed asserted it; but I shall make it appear to be an error as inconsiderately and hastily received, as started by some chimerical author; who, because several writers about that time observing the disease to begin in the pudenda separated it from another with which it was before confounded, must likewise take upon him to assert its being a new distemper, and to assign a certain time and place for its rise. Now one might reasonably expect, that, if the disease had its original there, it must have been so infallibly known, that there could have been no uncertain opinions about it, but that the physicians who resided in or near the place, and those more especially who interested themselves so far as to write of it, must have all agreed upon the certainty of a thing, the knowledge of the truth of which was so easily attainable. But on the contrary, Nicholas Leonicensus, who was the first Italian physician that wrote of this disease and who lived at the very time when Naples was besieged, is so far from acknowledging it to have had its rise there from the French soldiers conversation with the Italian women, and so little did he know of its true cause that he does not allow it to be the consequent of impure embraces. About this time it was likewise that Pope Alexander VI. engaged Gaspar Torella to write of this distemper. This Pope was in league with Alphonfus King of Naples against Charles VIII. King of France, to prevent his passing through Italy when he went to besiege Naples; yet this author is so far from allowing it to have had its original there, that he tells us the astrologers were of opinion that it proceeded from I know not what particular constellations. Nor does Sebastianus Aquilanus who lived at that time allow it to be any other than an ancient disease; or Antonius Scanarolius who wrote in 1498 which was but four or five years after the beforementioned siege. Nor do several others then living say one word about this Neapolitan story. But it seems Ulricus de Hutten, a German knight who was no physician, positively affirms this disease to have had its rise there; but how he should come to know this who lived at such a distance from the place, and they who were physicians residing as it were upon the spot be ignorant of it, will be as much credited as his following inconsistent relation, which will sufficiently prove how little care he took to be apprised of the truth of what he wrote. This very author tells us this disease was unknown till about the year 1493; that he himself had it when he was a child, and so consequently that it was either hereditary or from the nurse. He wrote his book of this distemper at Mentz, where it was printed by John Scheffer in 4^{to} in the year 1519. Now if

Of the antiquity of the venereal disease. By Mr. W. Becket, to Dr. W. Wagstaffe, n. 365. p. 47. May 1720. †Vol. V. P. I. C. VI. §. 19.

if we allow him to be but twenty seven years old when he wrote (for he cannot be supposed to be less who before this took upon him to cure his father of the venereal disease without the assistance of any physician or surgeon) he must have had the distemper upon him, according to his own account, before ever it was in being. Thus we may see how readers may be imposed upon by a hasty and inconsistent writer, if they will not be at the pains to consult the original writings of our predecessors, the only sure method of overthrowing such imaginary notions.

But to come to what is principally designed in this letter; if I have in my former sufficiently proved that the first degree of the venereal disease was very common among us some hundreds of years before it is commonly said to have been known in Europe; there will be no reason for any body to conceive we were at that time in any measure strangers to it when it came to be confirmed; more especially when we consider the methods of treatment in those times, which consisting principally in topical applications many of their patients could not possibly escape having it confirmed on them. Now when it was in this confirmed state, the writers of those early times looked upon it as an entirely new disease, and not a consequent of any evil before contracted, because they were not apprised that the first symptoms being removed and the disease to appearance cured, it should afterwards discover itself in such a manner as should not seem to have the least analogy with the symptoms that first attacked a part which had been for a considerable time free from any misfortune. But because the symptoms are the only true characteristics whereby we are infallibly able to know one disease from another, it may be expected that I produce sufficient authorities that they were all of them known and described by ancient physical and surgical writers, just as they appear to be in the venereal disease at this day: if I do this I cannot but think it will be satisfactory, since we can have no other way of coming to a knowledge of any distemper than by its symptoms. The method of laying down the exact succession of them will be impossible to be reduced to any certain and infallible rule, there being so great a variety of causes that obstruct such a regularity; for which reason I shall take notice of them in such order as they most generally appear, which was upon no account to be expected from our ancient writers, forasmuch as they mention every particular symptom by itself; not knowing but that they were independent of each other, and that each of them was a distinct disease. However, the proving these symptoms were in being in these early times will be as strong an argument of the antiquity of this distemper, as if they had been registered in the most exact order of succession, because we shall upon the strictest examination find they are peculiar to the venereal malady only. I have, I hope, sufficiently made it appear in my former letter that the first degree of this disease was anciently known among

us by the name of the brenning or burning; and that it was the same thing with what we now call a clap. The symptoms which are usually its concomitants are the phymosis and paraphymosis, both which are accurately described and proper remedies for them set down by the beforementioned John Arden Esq; in another manuscript of his, curiously written upon vellum and beautifully illuminated. The imprudent method of cure of this first degree of the venereal malady is sometimes attended with a caruncle in the urethra, which was a disease very common among us anciently: for not to mention other early writers, the above cited author gives us the case of a certain rector that had a substance like a wart growing in the penis, which in another place he says frequently happens, and of another which had an excrescence as big as a small strawberry, which (says he) proceeded from the corrupted matter that remained in the urethra.

And indeed there is not any symptom of the venereal disease that I find so often mentioned as this of the caruncle, insomuch that it seems to have been more common in those early times than at this day. But this must be certainly owing to the smooth and oily remedies they were continually injecting, which by their relaxing and softening the fibres of the part must necessarily dispose the contexture of small blood vessels lodged at the bottom of the little ulcerations to fill with nutritious juices, and to extend themselves so, as to form these fungous excrescences; and so solicitous were they to remove these inconveniencies that they made use of several corrosives and other methods; and a very early writer among us has given us a methodical and curious tract on this subject, wherein he recommends the removing them by the medicated candle which we use at this day, and lays down divers other instructions in relation to it, which makes it probably the best discourse on this subject that was ever yet written. The same author takes notice of those contumacious ulcers that happen upon the glans and the neighbouring parts, which we now call shankers; and the great trouble our ancient authors found in attempting their cure sufficiently discover them to have had their original from a venereal infection. These several symptoms of the venereal malady our early writers are very full in their accounts of, and others when the disease was in a more confirmed state to which they appropriated particular names, perhaps more significant and expressive than those imposed by modern authors. Thus for instance, the bubo's in the groins they called dorfers, which I have given a reason for before; and the venereal nodes on the shin bones they termed the boonhaw, which gives us a perfect idea, not only of the part affected, but after what manner it was diseased; for the old English word, hawe, signified a swelling of any part. Thus for instance, a little swelling upon the cornea was anciently called the hawe in the eye, and the swelling that frequently happens on the finger on one side the nail was called the white hawe, and afterwards whitflaw. The process our last

last mentioned author recommends for the cure of the boon or bone hawe is by making use of a plaister which had a hole cut in the midst to circumscribe it, and applying a caustic of unslacked lime and black soap incorporated together, which with plaister and bandage was to be secured on the part four hours, and longer if that was not found sufficient; after this he proceeds to the separating the slough, &c. This practice of his seems to have been found out by accident. For he tells us that when he was a young practitioner, he having applied both the natural and artificial arsenic to the leg of a man that was his patient, it so mortified the flesh as surprized him; but by proper digestives the eschar coming off and leaving the bone bare, he scraped it with an instrument for several days and dress'd it with incarnatives designing to have ingendred flesh on it; but this proving unsuccessful he continued to scrape it till he observed it move under the instrument, after which having separated it he found the sore covered with new flesh, and that the bone was four inches in length two in breadth and very thick, upon the removal of which the patient was soon cured. Thus it's probable this observation of this great man led our predecessors to practise the very same method; and we do at this day in our hospitals treat the venereal nodes on the shins exactly as is here described, where we observe the same appearances he so long before took notice of; and it is not in the least to be doubted but the boon haw and our venereal nodes are the same disease. By the appearance of some of the last of the abovementioned symptoms we infallibly judge the patient has had the infection upon him a considerable time, and that the disease is making its gradual advances to the corrupting and destroying the whole frame of the body. That this was the conclusion of the miseries of those persons that gave themselves up to the deceitful delights and entertainments of lewd women in those early times as well as now, I cannot better prove than by those remarkable instances which you quoted from a MS. in Lincoln college Oxon and kindly communicated to me. They are as follow,

“ Novi enim ego magister Thomas Gascoigne, licet indignus, sacrae
 “ theologiæ doctor, qui hæc scripsi & collegi, diversos viros qui
 “ mortui fuerunt ex putrefactione membrorum suorum genitalium
 “ & corporis sui; quæ corruptio & putrefactio, ut ipsi dixerunt,
 “ causata fuit per exercitium copulæ carnalis cum mulieribus. Mag-
 “ nus enim dux in Anglia, scil. J. de Gaunt, mortuus est ex tali pu-
 “ trefactione membrorum genitalium & corporis sui, causatâ per fre-
 “ quentationem mulierum. Magnus enim fornicator fuit, ut in toto
 “ regno Angliæ divulgabatur, & ante mortem suam jacens sic infir-
 “ mus in lecto eandem putrefactionem regi Angliæ Ricardo secundo
 “ ostendit, cum idem rex eundem ducem in suâ infirmitate visitavit;
 “ & dixit mihi qui ista novit unus fidelis sacrae theologiæ baccalau-
 “ reus. Willus etiam, longe vir maturæ ætatis & de civitat. Lon-
 “ donii, mortuus est ex tali putrefactione membrorum suorum geni-
 “ talium

“ talium & corporis sui, causatâ per copulam carnalem cum mulieri-
 “ bus, ut ipsemet pluries confessus est ante mortem suam, quum
 “ manu sua propria eleemosynas distribuit ut ego novi anno Domini
 “ 1430.” Now what those instances mentioned from Arden, or
 these from Gascoigne who was then chancellor of Oxford, could pos-
 sibly be but venereal cases I would be obliged to any body to inform
 me. Certain it is no disease was ever known to be got by the car-
 nal conversation of women which first attacked the genitals causing a
 corruption and putrefaction of them, and afterward of the whole
 frame of the body, but that which is venereal. For nothing is more
 commonly known at this day than that after the venereal engagement with
 an impure woman, the penis is the part where the scene is first laid for
 the succeeding tragical appearances; and there, and in the neighbour-
 ing parts, do the symptoms of the disease as its retainers always first
 assemble, till the malignant poison taints the blood and other juices;
 which being conveyed over the whole frame of the human fabric, if
 not checked, soon brings about its total corruption.

What I have further to add in relation to this is, that since we do not
 find the disease mentioned by Gascoigne was distinguished by any
 particular name, and as great numbers must unavoidably die of the
 venereal malady at that time from the imperfect knowledge of those
 who had the treatment of the first degrees of it, it must necessarily
 follow that when the whole frame of the body had received a taint
 from the venereal poison so as to occasion its breaking out in scabs
 and ulcers almost all over its surface it must generally be called by the
 name of some particular disease, whose appearances had somewhat of
 an affinity to it. Now if we examine the nature of all the diseases
 that attack the human body we shall not find the venereal malady,
 when it arrives at this state, to bear a greater similitude to any than
 the leprosy, as it is described by the ancients: nay so great was the
 analogy betwixt these diseases supposed to be that Sebastianus Aquil-
 lanus has endeavoured to prove from Galen, Avicén, Pliny, &c. that
 the pox is only one species of the leprosy; and Jacobus Cataneus, a
 writer almost as early as the rise of the name of the pox, tells us it is
 not only possible there may be a transition from one of these diseases
 into the other; but that he saw two persons in whom the pox was
 changed into the leprosy: that is, from having great pocks or pus-
 tules on the surface of their bodies, from whence the pox is denomi-
 nated, they became ulcerous or scabby. This particular state of
 the disease anciently put the surgeons to a great deal of trouble: for
 finding that these ulcers were of a very contumacious and rebellious
 nature, they were obliged to make use of great numbers of reme-
 dies to conquer them. But they observed that they were all use-
 less unless mercury was joined with them. Now the dressing each
 particular ulcer being so very tedious, they ordered the patients to
 daub the ointments over the parts which were ulcerated; which done

they were wrapt in linen cloaths till the next dressing: but after a few days they were extreemly surprized to find their mouths began to be sore and that they spit very profusely; but they tell us to their astonishment that in a little time the sores became healed and the patients cured. And by this accident the method of salivating by unction was first discovered, which is in so much use among us at this day. From these and some other instances I have given of the industry and application of our predecessors, and with what sagacity they applied every accidental hint to the relieving their distressed fellow creatures from the misfortunes they laboured under, we ought to be led to the highest esteem and veneration of them (and so much the more most certainly) as they were principally our own country men, who can be proved, not only by the great numbers that came from foreign parts to be cured of their diseases in England, but by other reasons, to have excelled most of their contemporaries in the divine art of healing. Now although the foreign authorities before mentioned might be looked upon as sufficient to convince any one how our ancestors blended these two diseases together; yet shall I pursue my designed method and prove from our own writers, long before them, that although the pox was not only among us but in distant nations anciently confounded with the leprosy; yet so exact were our writers in their observations of the infectious nature of one species of that disease and describing the symptoms, as was sufficient to lead any person to the distinguishing between them so as to separate one disease from the other. I shall therefore first enquire into the manner how the leprosy was sometimes said to be got in those early times, and then examine the symptoms of the disease that attacked the patient. John Gadisden a very learned and famous English physician, who flourished about the year 1340, in an excellent work of his entitled *Rosa Anglica*, speaking de infectione ex coitu leprosi vel leprosa, says as follows, “ Primo notandum quod ille qui timet
“ de excoriatione & arsurâ virgæ post coitum statim lavet virgam
“ cum aqua mixta aceto, vel cum urina propria & nihil mali habebit;” and in another place speaking de ulcere virgæ he says,
“ sed si quis vult membrum ab omni corruptione servare, cum a muliere recedit quam forte habet suspectam de immunditie lavet
“ illud cum aqua frigida mixta cum aceto, vel urina propria intra
“ vel extra præputium,” speaking still of the leprosy he likewise recommends a decoction of plantain and roses in wine, to be made use of by the woman immediately after the venereal encounter; upon which he tells us she will be secure. From hence it is evident some of their leprous women (as they called them) were capable of communicating an infectious malady to those that had carnal conversation with them, which proves that the pudenda of the women must be diseased, since we are absolutely assured infections of that nature only happen when a sound part comes to an immediate contact with a diseased one; for the

the symptoms always first display themselves in those parts through which the virulency is first conveyed. Now in a true leprosy we never meet with the mention of any disorder in those parts, which if there be not must absolutely secure the person from having that disease communicated to him by coition with leprous women; but it proves there was a disease among them which was not the leprosy although it went by that name; and that this could be no other than venereal because it was infectious: for there is no other disease that is capable of being communicated this way but the venereal disease, seeing the pudenda are only in that distemper so diseased as to become capable of communicating their contagion. I find the learned Gilbertus Anglicus who flourished about the year 1360, reasoning concerning the manner how it is possible a man should be infected by a leprous woman, where if we allow him to call the malignant matter which is lodged in the vagina [the woman's seed] we shall find he accurately describes the very first venereal infection, by part of the virulent matters being received into the urethra; from whence by the communication of the veins and arteries it is conveyed into the whole body, after which (says he) ensues its total corruption. Let us now examine the symptoms of one sort of their leprosy, for it must be necessarily divided into different species, when another distemper was blended with it in which we observe such a diversity of appearances; and this I shall the rather do in this place because it will furnish us with the next succession of symptoms after those already mentioned, as the venereal ozænas, the ulcers of the throat, the hoarseness, its being communicable from the nurse to the child, by hereditary succession, &c. All which we find to be true in the venereal disease at this day. Our countryman Barth. Glanville, who flourished about the year 1360, in his book *de proprietatibus rerum* translated by J. Trevisa vicar of Barkley in 1398 tells us, "Some leprous persons have redde pynples and whelkes in the face, out of whome oftenne runne blood and matter: in such the noses swollen and ben grete, the vertue of smellynge faylyth, and the brethe stynkyth ryght fowle." In another place the same author speaks of "uncleane spotyd glemy and quytty, the nosethrilles ben stopyl, the wasen of the voys is rough, and the voyce is horse and the heere falls." Among the causes of this sort of leprosy he reckons lying in the sheets or easing nature after them; and others which the first writers on the pox looked upon to be capable of communicating that contagion: also, says he, "it comyth of fleshly lyking by a woman, after that a leprous man hathe laye by her; also it comyth of fader and moder; ann so thys contagyon passyth into the chylde as it ware by lawe of herytage. And also when a chylde is fedde wyth corrupte mylke of a leprouse nouryce." He adds "by what ever cause it comes you are not to hope for cure if it be confyrmyd; but it may be somewhat hidde and lett that it distroye so soone." Thus we see how

our author under the name of one species of the leprosy gives a summary of the symptoms of the pox, and the several ways whereby it is at this time communicated. Now when these two diseases were anciently blended together and passed under the name of the leprosy only, it must be the real cause why that disease seemed to be so rife formerly; for two distempers passing under one name must necessarily make it more taken notice of and much more frequent; not but that much the greater number of those who were formerly said to be leprous were really venereal seems to be very evident; for since that disease has been separated from the leprosy it has drawn off such vast numbers that the leprosy is become as it were a perfect stranger to us. Those that are acquainted with our English history well know the great provision that was anciently made throughout all England for leprous persons, insomuch that there was scarce a considerable town among us but had a lazarus-house for such diseased. In a register which belonged to one of these houses I find there were in Henry the VIIIth's time six of them near London (viz.) at Knight's Bridge, Hammer-smith, Highgate, Kingland, the Lock, and at Mile-end, but about forty years before I find but four mentioned; and in 1452 in the will of Ralph Holland, merchant taylor, registred in the prerogative office, mention is made but of three, which, with his legacies to them, are as follow. "Item lego leprosis de Lokes, extra Barram
"sancti Georgii 20 s. Item lego leprosis de Hackenay (which is that at
"Kingland) 20 s. Item lego leprosis sancti Egidii extra Barram de
"Holborn 40 s." from which 'tis worth while to note that the Lock beyond St. George's church and that at Kingland are at this time applied to no other use than for the entertainment and cure of such as have the venereal malady. Some of our learned antiquaries have been much concerned to know the cause why the leprosy should be so common in those early times and so little known among us now: but I believe the reason will be impossible to be assigned unless we allow according to the proofs which I have already brought that the venereal disease was so blended with it as to make up the number of the diseased. It seems to have been the same thing with them in France as with us: for the author of the history of that kingdom, which was lately published here in two volumes in octavo, tells us that the house of the fathers of the mission of St. Lazarus was formerly an hospital for leprous people, but that disease being ceased in this last age (since the pox has been separated from it) these lazarus houses have been converted to other uses; and it may not be perhaps foreign to my purpose to take notice that the writ de leproso amovendo contained in the register of writs was, according to Coke upon Littleton, to prevent leprous persons associating themselves with their neighbours, who appear to be so by their voice, their sores, the putrefaction of their flesh, and their smell. Well then, let us examine what method was to be taken to prevent this noisom and filthy distemper the leprosy;

why truly that which would infallibly prevent their getting the pox after the usual method; and that was castration. It is certain that eunuchs are rarely or never troubled with the leprosy, according to Monsieur le Prestre, a counsellor in the parliament of Paris, who has these words “Antipathia vero elephantiasis veneno resistit: hinc eunuchi & quicunque sunt molles, frigidae & effeminatae naturae nunquam aut raro lepra corripuntur, & quidem quibus imminet leprae periculum de consilio medicorum sibi virilia amputare permittitur.” And Mezeray says he read in the life of Philip the August that some men had such apprehensions of the leprosy, (that shameful and nasty distemper) that to preserve themselves from it, they made themselves eunuchs. Now it is highly probable that those who submitted to this painful operation, had before observed that such as gave themselves up to the free use of women fell at length into that loathsome distemper, and so concluded the only way to preserve themselves from it was to be disabled for such engagements; which sufficiently proves that this species of the leprosy was infectious, and for the reasons before assigned could be no other than venereal; for how the true leprosy should be prevented by such means will be, I believe, impossible for any person to determine. There yet remains one very considerable symptom of the venereal malady to be taken notice of, because it is looked upon to be the most remarkable in that disease, and that is the falling of the nose; but since it has been already proved that this disease, when it had arrived to such a pitch as to discover itself by those direful symptoms as are the immediate forerunners of this, was by the ancients confounded with the leprosy and called by that name, it must be among the symptoms of that disease we are the most likely to meet with it, if any such thing as the falling of the nose was known among them. Now the most likely method of coming to a certain knowledge of the infallible symptoms of the leprosy of the ancients in its more confirmed state, is to consult the examinations those unhappy persons were obliged to undergo before they were debarred the conversation of human society and committed to close confinement: but this being a thing some ages since laid aside, no author that I know of having the particular history of it, and somewhat of it being absolutely necessary in this design, I shall do it as briefly as I can from what remains I have met with in records and other scattered papers. First then, after the persons appointed to examine the diseased had comforted them by telling them this distemper might prove a spiritual advantage; and if they were found to be leprous it was to be looked upon as their purgatory in this world; and although they were denied the world they were chosen of God: the person was then to swear to answer truly to all such questions as should be asked; but the examiners

* Centur. 1. Cap. 6. de separatione ex causa luis venereae.

were very cautious in their enquiries, lest a person that was not really leprous should be committed, which they looked upon to be an almost unpardonable crime: they considered the signs as univocal, which properly belonged to that disease, or equivocal, which might belong to another, and did not upon the appearance of one or two signs determine the person to be a leprous; and this I find to be the case of the wife of John Nightingale Esq; of Burntwood in Essex, who in the reign of Edward the IVth an. 1468 being reported to be a leprous, and that she did converse and communicate with persons in public and private places, and not (according to custom) retire herself, but refused so to do, was accordingly examined by William Hattecliff, Roger Marcall, and Dominicus de Serego the king's physicians; but they upon strict enquiry adjudged her not to be leprous, by reason the appearances of the disease were not sufficient: some of the questions put to the leprous persons (as they called them) which will more fully confirm what I have before advanced I shall now give as I transcribed them from an ancient book of surgery, "yf there
 " were any of his lygnage that he knew to be lazars and especially their faders and moders; for by any other of their kynred
 " they ought not to be lazars, then ought ye to enquire yf he hath
 " had the company of any lepreus woman, and yf any lazare had
 " medled with her afore him, and lately, because of the infect matter and contagious filth that she had received of hym. Also yf
 " his nostrills be wyde outward, narrow within and gnawn. Also yf
 " his lips and gummes are foul styinking and coroded. Also yf his
 " voice be horse, and as he speaketh in the nose." Now the signs which are here mentioned, were looked upon to be univocal: and these were they that made the examiners principally determine the persons to be leprous; but what determinations any one would immediately give from such symptoms now no person is surely ignorant of. But even these certain appearances would not always satisfy some persons, if we may believe Fælix Platenus in his medicinal and chirurgical observations, lib. 3. who tells us some did not look upon them to be so till they had an horrible aspect, were hoarse, and noses fell. Likewise in the *Examen leproforum* printed in the *De Chirurgia scriptores optimi*, the author speaking of the signs of the leprosy relating to the nose begins thus, "*Si nares exterius secundum exter-*
 "*orem partem ingrossentur, & interius constriquantur, & coarctentur.* Secundo si appareat cartilaginis in medio corrosio, & casus
 "*ejus significat lepram incurabilem.*" And the beforementioned John Gadsden in his chapter de lepra says as follows, "*Signa confirmationis etiam incurabiliter sunt corrosio cartilaginis quæ est inter foramina & casus ejusdem.*" Thus have I proved we had a distemper among us some hundreds of years before the venereal disease is said to have been known in Europe, which was called the burning; that this burning was infectious, and that it was the first degree

degree of the venereal disease; that this being common at that time, from their method of treatment the pox must be unavoidable: that it had exactly the same appearances it has now, although they were generally called by different names, that the ancients confounded it with the leprosy; that the vast numbers of leprous persons among us before the venereal disease was separated from it, and the small number we observe at this time is a flagrant proof of the former; that in describing the symptoms of the leprosy they give us those of the venereal malady; and by mentioning how it is communicated they describe the ways by which the pox is got at this day; that such remedies were by them recommended to prevent the first attack of the leprosy as are at this time in use to prevent the first symptoms of the pox; and that the falling of the nose, which has been looked upon to be the most remarkable symptom of the venereal disease, was commonly observed in what they called the leprosy in former ages.

XX. 2. **I** was of opinion that what I had said in my two former letters had been so full and satisfactory, that I should have had no occasion to have given my self or any body else any farther trouble upon this head: but as I find there have been two objections made against what I advanced, I shall take upon me to answer them, and endeavour to prove they do not in the least invalidate the authorities I before produced. The first is, that the venereal disease so well known among us now, and the leprosy of former ages, could not be the same disease, because the leprosy is not to be conquered by salivation, which the other generally very readily yields to. In answer to this I must observe that the leprosy which we have among us at this time affects only the surface of the body, the skin generally appears scaly, with a certain deep red colour or small sores upon removing the scales, and sometimes a scabbiness with a redness of the skin which affects different parts of the body. I have known both the cheeks only affected, both the arms for the breadth of the palm of one's hand, sometimes the breast, the legs, and other parts; but this may and frequently does continue upon the patient during life without making any farther progress; which shews it to be a cuticular disease. In these cases upon salivating the patients the scales generally fall off, the redness disappears, and the cure shall seem to be compleated; but in a month or two the same inconveniencies generally attend them as before. But one ought not to conclude that because our leprosy will but rarely be cured by salivation, and the pox generally will, that many of those whom the ancients judged to be leprous were not really venereal; for their leprosy, as they called it, was a quite different disease from ours. Had there been any proof brought that persons had been salivated in their leprosy and failed of cure it would have determined the case; but on the contrary we are assured by the learned Dr. Pitcairn in his dissertation concerning the ingress of the lues venerea, that the leprosy, before the Neapolitan disease.

*Continued by
the same, to
Dr. Halley.
n. 366. p. 108.
Sept. 1720.*

disease was talked of, was cured by mercury, and now since it changed its name it is no longer heard of. Thus we find that their leprosy and our venereal disease would be cured by the same method, but their leprosy and ours being absolutely different diseases, we by no means ought to expect the same success from the same process of cure. I dare be positive that no body ever observed our leprosy to be attended with falling of the hair, hoarseness of the voice, speaking through the nose, consumption of the flesh, ulcers all over the body, corruption of the fleshy parts and of the bones themselves, filthy ulcers of the throat, corrosion and falling of the nose, all which are reckoned as symptoms of their leprosy; on the contrary, ours is a mild and almost inoffensive disease, which a person may be affected with during his life and never become worse; whereas the other by displaying itself under the symptoms before enumerated brings the patient to the most miserable end; besides this, their disease was got by coition as their authors assure us, but in our leprosy a diseased husband may cohabit with his wife as long as he lives, and he shall never be able either by coition or the immediate contact of the diseased parts with those that are found to communicate any evil. Had what our predecessors called the leprosy been the same disease which we call by that name now, they had not been so solicitous to make such large provision for them, or shut them up from humane society; for one of our leprous persons might have been among them and no body have known he laboured under any infirmity at all. From hence it is evident the disease so common among them was entirely different from our leprosy, the appearances of which bear no manner of analogy with the former. 'Tis from the symptoms of a disease and the manner of its being received that we generally know one from another; but the symptoms of most of their leprous persons, and the manner whereby the disease was got, will be found in no other disease that attacks the human body but in the venereal disease only; for here they so exactly agree, that we must in a manner do violence to our own reason if we deny them to be the same. I proceed now to answer the second objection, which indeed was long ago falsely asserted by Dr. Fuller the historian; viz. that the leprosy was brought into England from the holy war, and that the disease was altogether unknown among us before. This as I take it does not so immediately concern me, since all I take upon me to prove is, that what they called the leprosy is not the same disease we call by that name now, but another. However, I shall in a few words make it appear that this objection is likewise groundless, by observing that the first Englishmen that went over to the holy war made their first voyage in the year 1096, as our historians generally agree, and that some of them returned in 1098; but most certain it is that we had the leprosy among us before; for Wharton de episcopis Londinensibus and other historians assure us, that Hugo de Orivalle, one of the bishops of London, died here of the

the leprosy in the year 1084, which proves our countrymen did not bring that disease first from the holy war, because we had it among us before. The account William of Malmesbury gives of this bishop's disease is as follows. "Is post paucos ordinationis annos in morbum incurabilem incidit. Siquidem regia valetudo totum corpus ejus purulentis ulceribus occupans ad pudendum remedium transmissit. Nam credens asserentibus unicum fore subsidium si vasa humorum receptacula, verenda scilicet, excruciantur, non abnuit. Itaque & opprobrium spadonis tulit episcopus, & nullum invenit remedium, quoad vixit leprosus." Now 'tis highly probable, that if this had been a new disease which the bishop died of, the mention of it as such would not have escaped our historian, but on the contrary it seems to have been anciently known among us, because the remedy made use of for it was so, it having been recommended by Ætius and other physical writers several hundred years before this time; and I think 'tis very plain that the cutting off the testicles, and with them the vessels formed for the receiving the humours as expressed in the bishop's case, was by them looked upon to be of peculiar service, because 'tis probable that observing the disease to begin in these and the neighbouring parts they thought the very minera morbi would be by this means destroyed, and the disease either cured or the spreading of it prevented.

XXI. **P**estem Constantinopoli ex Ægypto communicatam tum historiis tum quotidianâ observatione constat. Nidum tamen in hac urbe sibi fecit, & quamvis nunquam fere veteris pestis desint semina, novus etiam subinde fomes advehitur. Ab hyemali intenso frigore satis bene sopitur; emicant tamen hinc inde scintillæ aliquot hyeme & vere: æstate incrementum sumit; autumnali tempore summo flagrat incendio. Venti aquilonares statis temporibus æstate flantes (etesiæ scil. hujus loci) quamvis frigidiusculi sint veneni tamen pestilentialis dilatationi haud obsistunt. Australes satis calidi, si constanter flent, æstivo tempore pestem supprimunt. Quoad symptomata pestis Constantinopolitana adamussim respondet pesti Novioma-gensi annorum 1636 & 1637, a Diemberbroeck descriptæ. † Humanum genus invadit; compertum tamen est unum vel alterum equum, canem, fœlemve peste bubonaria correptum, & mortuum. Vulgus (præcipue, cui angusta domi res est) tum Turcarum tum etiam Christianorum Hebræorumque; facile sibi persuasum habet divinitus missam pestem; hinc non cavet à contagio: politiores, & præcipue christiani sibi cavent.

Symptomata à † dicto auctore enumerantur ista, febres, bubones, carbunculi, exanthemata, capitis dolor, phrenitis, sopor, vigiliæ, anxietas, debilitas seu magna virium prostratio, visus turbulentus, cordis palpitatio, linguæ siccitas, vomitus, singultus, lumbrici, fluxus

Of the plague at Constantinople. By Dr. Em. Timone. n. 364. p. 14. Jan. 1720.

alvi, hæmorrhagia narium, menstruum profluvium, sanguinis mictus, sputum cruentum, dolores lateris, hepatis, renum, aliarumve partium. His adjicio ego lassitudinem artuum ulcerosam, horripilationem, subsequente aliquando calore sæpius non subsequente, nauseam sine vomitu, vertiginem, & motus vertiginosos, tremorem manuum statim à morbi initio. Nullum ex omnibus symptomatibus est inseparabile, imo nec tria illa pesti specialia, bubones dico, carbunculos, & exanthemata; febris sæpissime abest; ita ut regula ista generalis stabiliri possit: quando adsunt manifesta pestis signa certo statuere possumus morbum esse pestem: sed quando absunt signa ista non possumus certò statuere contrarium. Multis enim peste correptis, leni præcedente rigore quo nec catarrho se laborare quis suspicaretur, per plures dies ex istis signis non manifestatur nec minimum, postea autem catervatim erumpunt. Nonnulli post susceptum contagium levissimo tantum languore affecti, mox erectè obambulant & consueta munia sine incommodo exercent; tertiâ autem vel quartâ die statim corruunt animamque exhalant in viâ: & ne quis suspicetur apoplexiam vel quid aliud, post mortem demum nigræ maculæ deprehenduntur: fidem etiam facit tum præcedens causa contagii manifestissima, tum propagatum postea contagium. Multi etiam sine ullâ manifestâ læsione erectè obambulant sanantur, erumpentibus etiam bubonibus & carbunculis. Plerique tamen febricitant & graviter ægrotant. Vomitus & alvi fluxus cum subitâ virium concidentia & cum febre pestem indicant, & sine febre adhuc magis. Minime ex signis suspectis si dolor in emunctoriis communibus jungatur pronunciandum est esse pestem.

Pustula rubicunda ad semi-ciceris magnitudinem in extremo purulenta maligna est: in lividum enim carbunculum brevi excrescit. Carbunculi in omnibus corporis partibus indifferenter erumpunt, non exceptis labiis, linguâ, bulbis oculorum, glande penis, &c. Bubones tantum in emunctoriis. Glandulæ parvæ duræ circa collum malignæ. Exanthemata semper sunt lethalia. Bubones si cito ad supurationem tendant, spem promittunt. Non malum est si etiam non bene maturi ferro aperiantur. Multi per bubonis resolutionem curati, annis sequentibus, si peste infecta loca petant, eo in loco dolorem obscurum sentiunt in quo bubonem habuerunt. Pestis in aliquibus individuis per plures dies latitare potest, & postea in actum erumpere. A peste convalescere incipiens, si ante quadragesimum gravem aliquem in diætâ errorem fecerit, novo erumpente bubone moritur. Pro monstro habetur si quis à peste perfecte sanatus eodem anno peste corripiatur. Si dispositionem corporum ad octo gradus placeat revocare; intacta peste corpora dispositionem habent ut septem, & rudem merita ut unum. Infectas ædes per menses aliquot impune incolens tandem peste correptus fuit. † Senes difficillimè peste

† Cap. 4. Diemerb.

corripiuntur, facillimè pueri. Exteri multo magis periclitantur quam cives. Armenii omnium nationum minimè ad pestem sunt dispositi. Observo illos paucissimis uti carnibus; cepis, porris, alliis, vinoque maximè utuntur. Caro porcina in peste præsentaneum venenum est. Nil æque ad pestem disponit ac animi pathemata, ac præcipue intensus moeror & terror inopinatus. Lue venereâ infecti indifferenter se habent ad contagium: bubones tamen illis suppurantes in fistulas ut plurimum degenerant. Nitidæ ædes haud æque facile inficiuntur ac sordidæ. Cachectici, ictero laborantes, & variis aliis chronicis morbis confictati homines dantur, & tamen pestis spicula vel eludunt vel superant; roseâ è contra facie præditi & robustissimi moriuntur multi.

Suffumigia ex baccis juniperi, pice, sulphure utilia sunt, si diu noctuque continentur, ita ut ab inferiore parte totam penetrent domum. Odoramenta ex aceto haud inutilia censentur. Oleum succini naribus illitum optimum est. Vinum moderate sumptum, hilaritas animi, & bona victus ratio haud parvi momenti sunt in præservatione. Phlebotomia damnatur, & præcipue fera; sanguis è venâ sectâ fluens nullo modo multoties sisti potest; ex scarificationibus etiam pro cucurbitularum applicatione factis ad plures horas, hoc est ad mortem usque, sanguinem vi magnâ effluxisse observatum est. Vomitoria levia non profunt, fortia valde nocent: purgantia statim enecant. Sola spes in sudore & alexipharmacis. Communissimè utuntur in hac urbe theriaca Veneta. Lapis bezoar, quamvis genuinus, nullius fere est momenti. Judæi acidis utuntur. Armenii & Græci vino & spiritu vini. A carnibus & carniū jusculis relligiōse abstinent Christiani ad multos dies. Turcæ etiam hanc diætā non spernunt. Multi, quæ parvus tuberculus nullo livore insignis erupit, à carnibus abstinentes per hebdomadam sani obambulant, postea carnibus usi brevissimè mortui sunt. Opium crudum & opiata omnia bona sunt pro scopo præservativo, sæpe etiam pro curativo. Summum remedium Turcis magnatibus habetur oleum naphthæ, seu petroleum albicans, ad duas usque drachmas epotum in vehiculo ad libitum; convenit hoc cum camphorâ à nostris tantopere celebratâ. Quidam multos sanasse dicitur phlebotomiâ (primâ tamen morbi die) ad lipothymiam usque celebratâ, propinato postea haustu aceti acerrimi, in quo sanguinis draconis & boli armænæ ana drachmam unam dissolvebat. Phlebotomiæ negotium in medio examinandum relinquo; ast certe præstantissimum remedium est. Frictio rubificans tum in pectore tum in dorso, in locis utrinque cordi respondentibus, cum allio contuso fortissimè per aliquot horas celebrata proficua est. Radix hellebori, sectione factâ, carni ad emunctoria transversim infixâ utilis est. Pulli gallinacei vel columbini, seu vivi seu per medium secti, bubonibus & carbunculis & etiam regioni cordis applicati & sæpissime iterati (sed ultra semihoram non retinendi) utilissimi comperti sunt. Oleum succini & extractum juniperi in praxi sæliciter successerunt. Methodus prædicti Diemerbroeck per omnia utilis est huic pesti; certè bene de

peste scriptit auctor hic, excepto quod pestis causam nimis alte deducit. Barbette etiam haud est contemnendus.

Anno 1712. Pestis Byzantii in fine Maii mensis incrementum sumpsit. In fine Julii erat in summo furore. In determinato loco observatorem habui qui mortuorum cadavera ad nonaginta & supra uno die numeravit. Etesiae flabant vehementissime; cessantibus etesias auster flavit satis intense. Primâ post auster flatum hebdomadâ cadavera non numeravit in die nisi circiter quadraginta; secundâ hebdomadâ triginta circumcirca; tertiâ minus viginti: qui numerus in bonâ etiam urbis salubritate tali anni tempore singulis diebus non deest. Sic autumnali tempore pestis sopita est anno illo: sed ut plurimum tali tempore sævire solet, & mediâ æstate vel in fine æstatis incrementum sumere. Pestem vere incipientem autumnis sopitam alias etiam observatum est. Notandum est post solstitium æstivum pestem in Ægypto, quamvis ferocissimam, infallibiliter definere: causa altioris indaginis est. Climatis Ægyptiaci characterismus in hoc peculiari pestis phænomeno aliquatenus ad Smyrnam usque insulamque Chiam, ipsasque Hellesponti angustias sese extendit. Observandum ulterius etesias, ventos scil. aquilonares, cursum solis sequentes aerem vehere non excrementitiâ solum humiditate sed nitrosis particulis valde saturatum & imbutum. Ansa mihi fuit hujus rei cognoscendæ vestis quædam quâ nos utimur ex pilis caprarum textâ. Vestis hæc hygrosopii quoddam genus videtur; nam quâ parte sudore manuum vel colli fuerit antea madefacta, quamvis serescat & post multos etiam menses in usum denuo accipiat, horâ tamen dimidiâ vel unâ post ortum solis quando nimirum etesiae spirare incipiunt, talem madorem denuo contrahit ut maculâ nigrâ intensissimâ inficiatur. Vestis post duas vel tres horas denuo exsiccatur & macula evanescit. Hic duo sunt notanda: primum est, si simplici aquâ vestis illa fuerit sæpius imbuta & postea serescat, haud succedit hoc phænomenon madoris & maculæ, prout quando sudore imbuta est: secundum consideratione dignum est hoc; si forte fortunâ tempus sit actualiter pluvium, haud æque facile madere inficique maculâ vestem illam, dummodo actualiter pluviae non exponatur; ex quibus colligo, præter aqueas particulas, nitrosis salibus imbutum aërem ex Ponto Euxino huc advehi primo etesiarum flatu. Particulæ istæ nitrosæ à congenere salinis particulis à sudore vesti illi communicatis fixantur & retinentur, & combinatione factâ maculam efficiunt. Salibus igitur istis imbutus aer fermenti pestilentialis (quod indolis salino corrosivæ esse probabile est) dilatationi fomitem præbere potest. Ægyptium autem aerem, mediante vento austrino huc pervenientem, summe rarefactum & talium expertem salium, pestis dilatationi obsistere posse verisimile est: adde, quod calidus auster corpora ad transpirationem magis disponat.

Si quis quærat interim utrum pestis sanguinis coagulationem vel nimiam dissolutionem inducat? dico neutrum primario & immediate facere,

facere, sed utrumque posse accidere tum processu temporis tum ratione massæ sanguineæ in variis individuis, quoad principia activa, variantis. Primario autem & immediate pestis spiritus adoritur: liquidis subsequenter & solidis varia inducit mala, secundum varium tum liquidorum tum solidorum schematismum. † Hinc varia symptomata in peste & sibi è diametro opposita, quæ unico remedio vinci non possunt, sed prudentis medici requirunt judicium, ut quod opportunum est in actum deducatur. Generaliter tamen observandum ut citissime generosissima remedia & in magna dosi propinentur: ut in principio oleoso balsamica, & spiritibus amica volatilia usurpentur; ut omnes evacuationes præter sudorem vitentur; artificiales igitur non tentandæ, naturales sistendæ suis quæque appropriatis; (sic alvi fluxus salutariter sedatus fuit clystere astringente cui theriaca erat immixta,) si spiritus sint effrænes & peccent in motu aucto, quod à vigiliis potissimum cognoscitur, ut sistantur per opiata. Si contra necrosi seu languore afficiantur, quod ab effectibus potissimum soporis cognoscitur, ut suscitentur per volatilia & camphorata: ut sanguinis consistentia integra servetur in processu mali; quod fit acidis & terreis adstringentibus, ut venenum ad peripheriam alliciatur &c.

XXII. 1. **T**HE state of the bodies from which we took the bile for the experiments, was as follows.

1. One Belesleur, a soldier of twenty five years old, of a strong, robust constitution, having a flattish bubo on the hollow of his right groin died delirious. We found his heart of an extraordinary bigness, stuffed with black clotted blood; his lungs covered with a livid purple and adhering a little to the pleura. The liver was double the natural bigness and stuffed with a thick blood. The gall bladder was full of a black and greenish bile. The dura and pia mater by their blackness seemed to have been seized with a gangrenous inflammation. The inward substance of the brain was sprinkled over with an infinite number of small livid spots.

2. Mary Pisanne, aged thirty years, of a sanguine habit, had a bubo under her right arm-pit, with a delirium followed by a mortal sleepiness. In opening her body we remarked that the lungs were in their natural state. The heart was of a prodigious bigness, full of black coagulated blood, the left auricle livid and gangrenous. The liver, which was much enlarged, was all covered with purple; and the gall bladder filled with a black and greenish bile. The head was not opened.

3. Peter Moulard, of a tender, feeble constitution, about 14 years old, had a bubo under the hollow of the right groin which was very deep and never came well out. He became delirious with convulsions in which he died. We found his heart of double the natural bigness, containing a black thick blood; his lungs besprinkled with livid spots; the gall bladder full of a black and greenish bile. The head was not opened.

† Diemerb. cap. 7.

Experiments with the bile of persons who died of the plague at Marseilles in 1721. By Dr. Deidier. n. 370. p. 20. Jan. &c. 1722.

4. Jean Raynaud, cook, aged about twenty years, of a melancholy temperament, had his whole body covered with a purple livid colour, and a bubo under his left axilla; he died in a delirious phrenzy. Upon opening him we found two abscesses, one between the teguments and the left great pectoral muscle, and the other in the breast between the sternum and the mediastinum. His heart was very large, filled with black thick blood. The right auricle was of the breadth of three inches; the left was in its natural state. His lungs were covered with little livid spots, soft and pliant, without any hardness in their substance. The liver was larger and harder than ordinary, and was also full of livid purple spots; and the like were found in the substance of his brain, all the vessels of which were filled with black thick blood.

5. Jaques Audibert, aged about thirty five, of a melancholy complexion, four months after he had been cured of the plague, the mark of which was a bubo in the hollow of his right groin which came well to a suppuration, was attacked afresh with three carbuncles; one in the middle and the other two in the fore part of his arm. He had very little fever, with some small sickness at stomach; but a sudden delirium carried him off. Upon opening his body we found his heart of a prodigious bigness, the right auricle being five inches broad, and the left three. We found a little imposthume upon the body of the aorta. The lungs were covered with livid spots, and the liver appeared gangrenous. The gall bladder was of a very black colour. The duodenum and the rectum were inflamed. We did not open the head.

6. Venture Cajole, about forty years old, of a melancholy temperament, died without any outward eruption on the third day, of a violent fever attended with a sleepiness. We found the mediastinum torn towards the upper part. The pericardium was of a livid colour. The heart larger than in its natural state, by the swelling of its ventricles which were full of black thick blood, as usual. The liver also was very large and of a livid colour, with a carbuncular pustule on the side of the gall bladder, which was filled with very black bile.

7. Margueritte Bachaire, aged eighteen years, of a lively vigorous constitution, having two carbuncular pustules on the middle and inside of the thigh, with a sharp pain in the head, died delirious. We found the coverings of the brain of a blackish red, the cortical part of a livid colour and the medullary sprinkled with a few black spots, the heart of a prodigious size, full of a thick black blood; the liver also was very large, and the gall bladder very full of a black and green bile. There were several livid spots upon the surface of the intestines.

8. Louise Belingere, twenty years old, having a bubo in each groin died very suddenly without any dangerous symptoms. We found her heart all covered with a livid purple, much larger than natural, filled

filled with thick black blood, having a polypus in each ventricle. The lungs were in their natural state. The liver of a prodigious size, and the gall bladder full of bile of a deep green colour.

9. One named Rampeau, a peasant, aged about twenty, of a sanguine robust constitution, having had a carbuncular parotide for the space of eight days accompanied with a burning fever, was carried to the hospital the second of May and died the fifth. We found the outward part of the left side of the lungs covered with a livid purple. The heart was of double the natural bigness, having scarce any blood in the ventricles whose cavities were filled each with a large polypus, that on the right side having dilated the auricle to the breadth of four inches. The liver also was larger than ordinary, and the gall bladder was full of a black and green bile.

Exper. I. The bile taken from the gall-bladders of those who died of the plague at Marseilles has always been of a black and greenish colour; and became constantly of a lasting grass green on mixing spirit of vitriol with it; and always very yellow when mixt with oil of tartar per deliquium, or the alcalious fixt salt of the same dissolved in water. These two colours green and yellow, have continued for whole months. The said bile by the affusion of spirit of nitre became of a black colour like ink, which soon faded.

Exper. II. The said bile being poured into wounds made on purpose in several dogs they became melancholy, drowzy, would not eat, and died in three or four days with the essential marks of the true plague, such as buboes, carbuncles, and gangrenous inflammations in the viscera, exactly as in the human carcases from whence the bile was taken.

Exper. III. A drachm of the said bile mixed with two ounces of lukewarm spring water and injected into the jugular veins of several dogs, rendered them presently drowzy, and killed them in four hours, with gangrenous inflammations, the heart stuffed with black thick blood, the liver swelled, and the gall-bladder full of green bile.

Exper. IV. The same quantity of bile injected by the crural vein produced in the dogs a heaviness in about an hour. They had such a loathing of all food, that they would neither eat nor drink any thing after the injection. They pissed frequently, especially if they were stirred. On the third day there appeared considerable tumours under the axilla, and on their thighs about three inches from the wound. The wound turned to a gangrene, and the creature usually died on the fourth day with all the marks of the plague.

Exper. V. A dog that followed the surgeons when they went to dress the sick, used greedily to swallow the corrupted glands and the dressings charged with pus which they took off the plague-sores; he also licked up the blood that he found spilt on the ground in the infirmary; this he did for about three months, yet was always well, brisk, full of play and familiar with all comers. We injected into

the right crural vein of this dog about a drachm of the pestiferous bile mixed with two ounces of warm water. He died the fourth day, as the others did, with a bubo on the wounded thigh; on which likewise there were two carbuncles, and the wound was gangren'd. What we took particular notice of in this dog was that after the injection, both when he was living and after he was opened when dead, he had a very stinking smell, which we did not observe in any of the others. He had besides a considerable hæmorrhage from the wound the night before he died, having struggled hard to escape out of his confinement.

Exper. VI. May 2d having injected about a drachm of this bile mixed with two ounces of warm water, into the crural vein of a dog, he became presently drowzy, refused his food, and died the third or fourth day after the injection, with all the inward and outward marks of the plague.

Exper. VII. May 6th we collected the bile of this dog and injected it into the crural vein of another who presently after the injection had convulsive motions all over him, which were followed by a lethargic heaviness. On the second day after the injection there appeared a carbuncle upon the great pectoral muscle on the right side: the third day there arose a considerable bubo on the thigh; and the same day the dog died, having neither eat or drank since the injection. Upon opening the body we found the forepart of the breast all gangren'd under the teguments; and, in the inward parts the viscera were full of black clotted blood; as in all the rest. The outward surface of the lungs was all purple; the heart was swelled as big again as usual, with the four cavities full of black clotted blood.

May 10th we injected the bile of this second dog into the crural vein of a third who was thereupon seized with violent and different convulsive motions for about half a quarter of an hour. When he recovered from these he appeared dull and sleepy; and vomited with violent strainings, which was followed with a hiccup. He eat a little boiled meat, having fasted a good while before the injection was made, but vomited it up two hours after, and died the third day with all the symptoms of the plague.

*Continued by
the same. n.
372. p. 105.
June 8th.
1722.*

XXII. 2. **W**E caused two dogs to swallow a pretty large quantity of bile taken from the bodies of persons dead of the plague. Upon which they appeared heavy and melancholy, refused their food, and made water very often, especially when they were any ways disturbed. Their urine was thick and very fetid, and their gross excrements were tinged with the black and greenish bile which they had swallowed. But in a few days those accidents went off and the dogs recovered their perfect health, though they were all the time confined in a cellar with the other dogs that we tried our experiments upon.

XXII. 3. **A**Ccording to your proposal I laid some of the blood of a person who died of the plague upon a wound made in the crural vein of a dog, and covered it with a dressing which the dog got off in the night. I found next morning that the dog had licked his wound and refused his food. Towards night he began to bemoan himself, and gave signs of an approaching death. The morning after I found him dead, the wound being considerably swelled and gangren'd, and the edges round the swelling likewise gangren'd.

An experiment with the blood of one who died of the plague. By Dr. Couzier to Dr. Deidier. n. 372 p. 103. June &c. 1722.

Upon opening the body we found the liver something larger than usual, with spots of a livid purple as in the bodies of persons dead of the plague. In the stomach was found a quantity of black coagulated blood of the size of a hen's egg. This in all likelihood was what he had swallowed upon licking the wound. The heart was very large, with a black grumous blood in the ventricles, and the auricles were turned blackish and gangrenous.

XXIII. **A**Soldier, between the age of twenty and twenty five, of a lively brisk temper, being sick in the hospital of an ordinary malignant fever, died about the fifteenth day by a defluxion upon his breast. His lungs were found very much blown up, filling all the cavity of the breast and adhering to the pleura. Having remarked that the bile in the gall-bladder was of a bright grass green colour, we gathered it for experiments.

Experiments with the bile of persons who died of different diseases at Montpellier in 1721. By Dr. Deidier. n. 370. p. 28. Jan. &c. 1722.

Exper. I. Having mingled this bile with four ounces of warm water we injected part of it into the jugular vein of a dog, and a compress soaked in the rest of the liquor was applied to the wound. The creature thereupon appeared heavy and sleepy, and would neither eat nor drink; the third day he eat and drank willingly. The compress falling off the fourth day, the wound was diminished one half, and healing by little and little the dog grew perfectly well.

Exper. II. A peasant of about fifty or sixty years old, of a melancholy temperament, had been near a month in the hospital with an ordinary malignant fever, having alternately a delirium and a sleepiness. After his death, the bile was found extremely thick, black as ink, and in great quantity. We put about a drachm of it into a wound made purposely on the outer part of the right thigh of a dog, thrusting into the wound pledgets dipt in the bile diluted. There appeared no change in the dog. We also made him swallow some of the same bile, yet he did not lose his appetite; and seeing he was like to do well we left the wound to it self, which healed in fifteen days only by the dog's licking it.

Exper. III. Endeavouring to inject some of the same bile into the crural vein of another dog, the great thickness of the bile stopped the syringe and disappointed us; wherefore we took a pledget soaked in as much of this bile diluted as it could take up, and applied it to a fresh wound made in the inside of the right thigh. The pledget was fastened within the skin by some needles. This produced no considerable

derable alteration in the dog; he neither appeared sleepy nor lost his appetite but licked his sore readily enough; and after the pledget was fallen off the wound healed as in the last experiment.

Exper. IV. About a drachm of the same black bile mixed with warm water was injected into the jugular vein of another dog, who was no ways disordered thereby, but continued as brisk as before, only he appeared very thirsty and drank with greediness. Next morning we viewed the wound which we found black and dry, and the dog becoming surly bit one of the assistants. The two ligatures made for the injection being taken away no blood followed. We applied the ordinary digestive by a dossil, which was fastened with a bandage; and about four hours after we found the dog dead, having lived twenty three hours after the injection. On opening him we found that his heart beat still with violence, and when the beating ceased there was no blood either in the ventricles or auricles, but it was crowded together in the great vessels, and appeared of a lively red and very fluid, without any of those concretions which we constantly observed in all that died of the plague, of which this dog had no marks either internal or external.

Exper. V. An inhabitant of Montpelier, aged about thirty or thirty five, very fat and robust, of a sanguine complexion, had received a simple wound on the upper part of his forehead on the right side by a fall. This being neglected brought on an erysipelas all over his face, attended with a swelling of the left parotide. This appeared and disappeared thrice from morning till night. The erysipelas came on suddenly; he grew delirious, and died after fifteen or twenty days illness, reckoning from the fall. On opening the body we found a quantity of water between the skull and the dura mater. The brain, which was firmer than ordinary, was a little red, and part of the pia mater covering the hinder part of it appeared inflamed. There was about an English gallon of a yellowish water in the cavity of the breast. The great right lobe of the lungs was a little hard on the upper part. The heart had a polypus concretion in each ventricle: we found likewise two English quarts of limpid water in the lower belly. All the fat of his body was yellow. The liver appeared a little swelled, and the gall-bladder almost empty, not having above two drachms of yellow bile in it, which we mixed with two ounces of warm water and injected into the crural vein of a dog; he eat and drank heartily after the injection, and did not appear at all disordered. The wound bleeding much, we were obliged to fill it with restraining powders kept in by a pledget and bandage. Twenty four hours after, the dressing was taken away and the wound appeared black and dry. The dog licking it, it suppurated the next day and afterwards became red and well coloured; it was lessened one half in eight days, during which time the dog appeared in perfect health.

Exper.

Exper. VI. Eight days after the foregoing experiment, the dog that was the subject of it was killed by about half a drachm of powder of Hungarian vitriol dissolved in a spoonful of warm water and injected into the jugular vein. He died on the spot with universal convulsions. His heart was found full of grumous blood reduced to a kind of thick pap, but without any clots. The bile of this dog was yellow and in little quantity. Not being able to inject it into the crural vein of another dog, because the vein was too small, we contented our selves with dipping two compresses in it, which we applied and kept under his skin by two wounds made on purpose: there happened no notable change. We observed in these two dogs no marks either internal, or external, of the plague.

XXIV. **A** Paper omitted, its substance being in N^o 374. p. 209. n. 370, p. 49. of Trans. and in § xiv. of this Chapter.

A letter from Dr. Nettleton concerning the farther progress in inoculating the small pox to Dr. Jurin R. S. Secr.

C H A P. III.

AFFECTIONS of the HEAD.

I. **V**IR 35. annorum, temperamenti & habitus gracilis, correptus dolore gravativo capitis in parte anteriore versus frontem à medicis plurima accepit remedia, sed frustra: post duos annos hæmorrhagia narium larga contigit, quæ tamē sponte cessavit: post hæmorrhagiam amisit sensum olfactorium, deinde correptus paroxysmis epilepticis per duos annos sæpius ingruentibus, denique mortuus est. Secto cranio, vidimus cerebrum in parte anteriore versus duram matrem circa regionem cristæ galli in parte dextrâ durum & callosum, & arctissimè cum meninge durâ connexum: in parte cerebri anteriore versus sinistram partem inventa fuit extravasatæ materiæ sanguineæ aliqua quantitas; reliqua naturalia.

Observations on the brains of three persons who died of the epilepsy. By Mr. Walt. Curienfis n. 399. p. 315. July &c. 1727.

Anasarcâ laborans mulier 60 annorum vehementissimis iisque sæpè repetitis acerbissimis insultibus correpta obiit. Secto cranio, invenimus intrâ piam meningem & cerebrum atque in anterioribus cerebri ventriculis magnam satis extravasatæ lymphæ quantitatem, ut eâ ventriculi fermè turgidi fuerint. In plexibus choroïdeis conspectui sese præbuere plurima corpuscula albicantia, pellucida, serum aquosum in se continentia, variæ magnitudinis; maxima ad magnitudinem seminis cannabini majoris accedebant.

Dissecto cranio vetulæ cujusdam quæ per multos annos epilepsiæ valdè obnoxia fuerat, vidimus intra piam matrem & cerebrum mediocrem feri extravasati copiam, in anterioribus autem cerebri ventri-

culis tanta talis feri quantitas erat, ut crepaturam illorum quasi minaretur. Plexus choroïdæus instar veri racemi apparebat uterque; vesiculæ inibi plurimæ, rotundæ, pellucidæ, variæ magnitudinis & instar elegantissimarum apparebant perlarum.

A woman that could see only some parts of an object. By Dr. Abr. Vater. n. 384. p. 147. July &c. 1724.

II. **F**œmina mediæ ætatis anno superiori, a suppressa per balneum & subsecutam refrigerationem coryza, unica nocte incidit in cataractam nigram seu guttam serenam: nam mane e somno erecta usu oculorum orbatam se sentit, nullo extrinsecus in oculis vitio apparente. Post usurpata vero medicamenta varia laxantia & sanguinem purificantia, interpositis simul vesicatoriis, una cum decenti diætâ visus sensim rediit, ita tamen ut notatu dignæ visus vicissitudines ac singularia in eo phænomena occurrerent. Primum enim omnes ipsi obvios homines capite quasi truncatos vidit, solo corpore absque capite in oculos incurrente. Successu temporis objecta quidem tota, sed quasi per nebulam aut per rete vidit, & hoc cessante maculas tamen & flocculos oculis obversari percepit. Tandem affectus hic in visum partialem quo hoc ipso tempore adhuc laborat degeneravit. Nunc enim, utroque oculo aperto & versus objectum directo, illud quidem totum conspicit: alterutro vero eorum clauso, pars objecti macula aut nebula rotunda tecta videtur, quæ macula tanto major apparet quo longius oculus ab objecto removetur. Prout autem oculus sive dexter sive sinister occluditur semper quidem media objectorum pars, at diversa, obscuratur. Ita si, e. g. has tres voces in charta scriptas (EGO SUM COECA) intueatur oculo sinistro tantum, pupilla versus mediam vocem SUM directâ, hæc in visum non incurrit, sed tantum duæ voces EGO—COECA conspiciuntur. Pupilla vero versus vocem EGO directâ, hæc evanescit ita ut tantum—SUM COECA videat. Quod si e contrario oculum sinistrum claudat & oculo dextro inspicat objectum, tunc medium quidem pariter obscuratur, ita tamen ut tantum pars quarta visum fugiat, tribus partibus clare conspectis. Ita si, e. g. oculo huic objiciat has quatuor voces in charta scriptas, (EGO OPTO ESSE SANA) tunc pupilla ad medium directâ omnes voces videt præter vocem OPTO, quæ macula rotunda obscuratur. Quoniam ergo ex hoc casu apparet maculam illam rotundam qua pars objecti obscuratur esse fixam quidem, sed pro varia pupillæ directione locum mutare, dubium videtur utrum vitium in humore crystallino, an in tunica retina hæreat? in tunica quidem cornea nulla obscuritas aut macula patet. Majoris vero momenti ac explicatu difficilior videtur antecedens phænomenon, ubi ægra totum hominis corpus excepto tantum capite conspexit.

Observations on cataracts. By Sig. Ant. Benevoli to Dr. Valsalva. 373. p. 194. Sep. &c. 1722.

III. 1. **T**HE author says that July 13. 1720. he couch'd a German soldier of cataracts in both his eyes, who immediately after the operation recovered the sight of them both, and continued to see till his death, which happened of an acute illness Apr. 6. 1722. Sig. Benevoli took the eyes out of their orbits, in order to examine whether the cataracts consisted of a membranous pellicle, as some

writers

writers maintain; or, as others pretend, of a preternatural opacity in the crystalline humour. Upon a careful and very exact examination of all the contents of the left eye, he could not find any such thing as a pellicle within it, but discovered a small yellowish body at the bottom of the bulb of the eye, of a lenticular shape, without adhesion to any of the other parts, which being taken out appeared to be the crystalline humour grown opaque and something less than its natural size, having two or three small dents in its circumference, which it had received from the needle during the operation of couching. Next day he examined the right eye in the same manner, in the presence of several curious persons, and found in it the crystalline grown opaque and depressed, in the same manner as the former, to the bottom of the eye, still carrying the marks of the needle evidently upon it, but found no pellicle within the eye, notwithstanding the most diligent search he could make for it. Sig. Benevoli farther relates, that in some experiments which he formerly made upon the eyes of dead subjects at Bologna in company with Dr. Valsalva, he introduced the needle into the eye in the same place and in the same manner as is commonly practised in couching, and afterwards dissecting the eyes he always found that the needle had passed into the eye on the backside of the crystalline humour, so that it would have been impossible to bring the needle forward from thence into that part of the aqueous humour which is seated between the uvea and the crystalline humour, in order to depress a pellicle seated there, according to the common opinion, unless he had passed his needle through the body of the crystalline.

He likewise observes that the space between the uvea and the crystalline humour is so very narrow that though he finds it not impossible to introduce a needle into it, yet there is by no means room enough to turn the needle up and down in all directions, with that freedom that is used in couching cataracts, without wounding either the uvea or the crystalline.

Lastly, he observes that in his long practice of couching cataracts, having generally couched about twelve or fourteen in a year, he always found that he worked upon a hard and resisting substance, which being tenderly touched by the needle would vibrate and fluctuate backwards and forwards, and would sometimes return against the needle with a sensible impetus, which by no means agrees with the common notion of the cataract's consisting in a pellicle or membranous substance.

III. 2. **S**ept. 21. 1723. I was consulted by one W. Sollars, aged fifty, who complained of a decay in his sight; upon examining his eyes I found two cataracts, that in his right eye almost ripe, the other just forming. There being no other obvious method of relieving him I proposed the operation, but first advised him to consult some others of the profession, and accordingly he advised

An eye with a cataract dissected. By Mr. J. Ranby. n. 381. p. 36. Jan. 1724.

with

with the ingenious Mr. Tanner, who upon viewing his eyes declared them both cataracts, but that neither of them was as yet fit for the operation. In the mean time the poor man fell ill of a fever and died the second of March. Having procured the right eye, in which the cataract was most confirmed, I made an exact dissection of it, and found the aqueous and vitreous humours in their natural state, but the crystalline was opake, of a foul pearl colour, and more solid substance than in its natural state. The generally received opinion that a cataract is a film growing behind, or sometimes before the pupil, made us examine both chambers of the aqueous humour with the utmost exactness; but all to no purpose, for the aqueous humour had its natural transparency, nor could we observe any thing preternatural either on the iris or uvea, except too great a contraction of the pupil. This very much strengthens the opinion of Maitrejan, Brissé, Heister, and Valsalva, who have severally asserted that a cataract is only an opacity of the crystalline humour, and that it naturally proceeds from a serous acid so far astringing and corroding its substance as to destroy its transparency. This Maitrejan confirms by an experiment of immersing the crystalline humour in a composition of three parts water and one aquafortis, by which he tells us it may be rendered hard and opake; but in this point I cannot help joining with the learned Dr. Pitcairn, who has sufficiently proved that there is no such serous acidity in an animal body. To me nothing seems more easy than to deduce this opacity of the crystalline humour from an inflammation in the blood, or an increased momentum in the fluids with which it is supplied: for in that case grosser particles, inconsistent with transparency, may be impell'd into the lymphatic vessels of which it is composed. That there is an inflammation is sufficiently demonstrated from hence; first, the patient feels often a pungent pain in the eye, which as it is generally the forerunner of a cataract, so it certainly indicates an inflammation of the part. Secondly, the iris, whose colour arises from the blood-vessels, changing from a lighter to a darker colour shews the violence of the inflammation, and is therefore esteemed a symptom of the worst consequence. Thirdly, those maculæ which appear as it were swimming in the air plainly prove that there are opake particles already entered the lymphatic vessels which compose the vitreous humour.

*Two eyes with
cataracts dis-
sected, By —
ro S. Molineux
Esq; n. 384. p.
149. July &c.
1724.*

III. 3. **J.** Wright, senex milesque emeritus, suffusione seu cataractâ utriusque oculi laborans, visu tandem omnino privatus est. Curæ se commisit D. Caywood oculistæ Dubliniensis, qui acu punctoriâ oculum utrumque perforavit ad crystallinum è sede suâ deprimendum. Operatione verò in oculo dextro minus feliciter succedente sinistri usum solummodo recuperavit. Paucis mensibus post operationem peractam in hospitium regale militum emeritorum prope Dublinium receptus est, ubi per annos octo vel novem mansit, & per totum istud tempus visus aciem satis acutam habuit, adeo ut per urbem

solus

solus ambularet & sodalium facies distinguere posset. Mortuus est tandem quinto die Apr. 1722. suffocatus per casei morfulum hærentem in gula, quam adeo arctam habuit ut eundem mortis aditum paucis abhinc annis bis ægre evaserit. Oculi ejus e cranio exempti missi sunt per nosocomii chirurgum ad T. Molyneux M. D. In ædibus ejus cultro anatomico aperti sunt per oculistam supradictum, meque ut interesset operationi accersere dignatus est. In oculo sinistro (cujus aciem recuperatam fuisse supra notavimus) sublatâ corneâ cum portione tunicæ scleroticæ, ne vel minimum invenimus rudimentum pelliculæ in aqueo humore fluctuantis aut limbo iridis adnatæ, sicut se observasse scribit Wolhoufius. Quod vero multo magis mirandum est, nullæ prorsus reliquæ inventæ sunt humoris crySTALLINI, cujus opacitati morbum adscribit D. Brisseus. Humor vitreus, quoad situm & consistentiam, nihil præternaturale oculis nostris exhibuit; tunica choroïdea & retina fusci coloris erant tam intus quam extra. In oculo dextro eadem omnia observavimus; nullum nempe pelliculæ aut crySTALLINI rudimentum occurrebat. Tunica cornea rugosa erat & flaccida, quod aqueus humor per puncturam extravasatus nunquam renovatus sit: adeoque istius oculi usum amisit penitus. CrySTALLINI vero defectum quod attinet res est prorsus inaudita, neque ab ullo anatomico, quantum scio, defuisse observatus est vel leviter suspectus. Militem hunc crySTALLINUM habuisse in utroque oculo ante operationem nullus dubito; cum vero acu a sede sua detrusus est, ligamentis ciliaribus vasisque quibus nutrimentum hausit penitus disruptis, eum sensim contabuisse credo, tandemque in auras dissipatum fuisse. Summopere vellem hanc rem experimento sæpius iterato confirmatam esse: suspicor enim idem semper evenire statim tempore post depressum crySTALLINUM. Hoc certo constat, hominem nempe absque crySTALLINO videre posse, contra opinionem Wolhoufii eâque amplius confirmatur sententia D. Brissei de cataractâ.

III. 4. **V**etula 50 circiter annorum habebat cataractam veram in oculo sinistro, coloris perlacæi, magnitudine mediocri, ita tamen ut paulo plusquàm dimidiam, eamque mediam pupillæ partem occuparet; illam vidi manifestè post uveam, & in 2dâ oculi camerâ esse suspicabar. Interrogatus à Santorino, præsentibus decem plus minùs medicis, quid judicarem de hac cataractâ, essetne cuticula an crySTALLINI vitium? respondi, me potius pro cuticulâ habere quam pro crySTALLINI vitio, attamen id absolute affirmare nolle, quoniam signum pathognomonicum non daretur. Respondenti mihi ridere cœpit quod auderem aliquid de cuticulâ sive membranulâ statuere; persuasus enim est ipse Heisteri systema certum esse &c. Mortuâ dissectâ crySTALLINUS humor omnino pellucidus inventus est, nec ullâ maculâ aut minimâ obfuscatione imbutus; erat tamen per totam ipsius molem ubique & æqualiter sed levissime citrino colore perfusus, vix namque aliquid hujus coloris apparebat vivâ adhuc vetulâ: cuticula autem libera in nominatâ camerâ existerat, & non nisi duabus subtilissimis

Of the substance of a cataract. By M. Walt. Curienfis. n. 399. p. 317. July 1727.

A prodigious quantity of matter running out of a boy's mouth. By Dr. Pet. Hardisway. n. 400. p. 374. O. 7. &c. 1727.

lissimis fibrillis uveæ adhærebat; pupilla naturali quoque aliquantulum major reperta; cætera erant naturalia.

IV. **F**Ébr. 6. 1724. vocatus sum ad puerulum decennem, qui à sex septimanis febre lentâ decumbebat malè multatus. Præscriptis quæ res postulabat remediis intrâ sex vel septem dierum spatium a morbo liber evasit: verùm diebus aliquot elapsis ingens in genæ dextræ interioribus subortus est tumor, puero nihilominus quoad cætera benè valente. Ore ægrè diducto in conspectum venit ingens puris quantitas, at unde manaret præ pueri proterviâ non licuit pro hac vice explorare. Ideo consulebam tantùm ut ficum in lacte coctam ad tumorem emolliendum atque si fieri posset rumpendum admoverent. Mane sequenti os incredibili ferè puris copia teterrimi odoris (tumore intereà disrupto) difflebat. Gargarismate modicè detergente præscripto, circâ vesperum pus pari omninò quantitate atque priùs depluebat. Mirabar sanè unde hoc provenire posset, cùm ulcus in genâ tanto proventui nequaquàm sufficere videretur; suspicabar autem (foetore præ cæteris suadente) materiæ istius fontem in capite alicubi intrâ ossa latitare: quod cùm paulò diligentius investigarem, ecce os maxillæ superioris ad dextras carne (quæ quasi semicocta utrinque recesserat) denudatum prorsus atque carie correptum, & ex dentium alveolis (dentes enim puerulus, ceu inutiles, suis nullo negotio jam extraxerat digitis) hoc materiæ purulentæ profluvium jugiter delabi: quapropter chirurgo è viciniâ advocato commissum est negotium. Huic suadebam ut dum ossis medellæ incumberet ulceris itidem detersioni & consolidationi operam daret; verùm quicquid dicerem nulla quæcunque genæ suppuratæ adhibere voluit medicamina: quo factum est ut ea iterum in molem ingentem atque alterâ (sinistrâ sc.) duplò major citò excreceret. Mandibulæ cariosæ solummodò penicillum tincturâ quâdam, forsàn myrrhæ, imbutum applicabat. At longo temporis spatio tandem emenso, cùm parùm suâ tincturâ proficeret, hamulo admoto, quod temporius factum debuerat, os mali integrum evehebatur. Ab ossis extractione gena nequicquàm subsidebat sed potius incrementum sumebat, & materiæ purulentæ copia nullatenus minuebatur. Osse autem abrupto ossis palati dimidium cum narium septo absumptum est; parte etiâ infimâ orbitæ oculi simul abreptâ. His addendum quod tumore processui zygomatico superstiti incumbente, gena mole duplò insignior sinistrâ extat & oculum pœnè claudit, pure quasi ex fonte perenni indefinenter fluente.

Die 24. Decemb. 1727. Triennium fere jam elapsum est, & tumor in eodem adhuc remanet statu, materiâ puriformi os & fauces prò solito irrigante. Puer cætera sanus edit, bibit, dormit, & unâ cum aliis suæ ætatis quotidie alacriter ludit.

Fig. 69.

Fig. 69. Facies ossis externa.

a, a, a, a. Alveoli dentium.

b. Dens molaris remotior.

c. Pars orbitam oculi faciens.

d. Pars

- d. Pars ossis ubi abruptum circa nasum.
- e. Pars ossis ubi processus zygomaticus terminatur.
- f. Pars ossis sub labium superius.

Fig. 70. Forma interior ossis.

- 1 Pars ad Nasum abrupta.
- 3 Pars mandibulæ exterior & dentis alveolus.
- 4 Pars ossis oculum attingens.
- 5 Pars maxillæ remotior.
- 6 Pars naris dextræ, septo abrupto.
- 7 Dens molaris.

Fig. 71. Os resupinatum exhibit.

- D, D, D, D. Pars ossis palati.
- E, E, E. Alveoli dentium.
- F, F. Pars mandibulæ exterior.
- G. Pars anterior ejusdem.
- H. Dens molaris.

Fig. 72. Facies interior ossis parùm reclinati.

- A, A, A, A. Pars mandibulæ, & alveoli dentium.

B. Locus ubi os abruptum circa nasum.

C. Pars ossis oculum attingens.

D. Maxillæ pars remotior.

E. Dens molaris remotior.

F. Pars ossis palati.

G. Pars naris dextræ septo abrupto, ut in fig. 70. n. 6.

V. 1. **F**ŒMINA rustica in Polonia, anno ætatis decimo quinto viro nupta, incidit decimo octavo in morbum Poloniæ endemium, qui plica Polonica a capillo inenodabili vocatur. Hanc plicam per 50 annos fœmina gestavit, ac per totum fere illud tempus dolore arthritico et contracturis tandemque marasmo universali corporis afflicta lecto affixa fuit, senio denique confecta anno ætatis 78 diem obiit. Illam adhuc viventem non tantum vidit & ad vivum depingi curavit, sed et ipsam plicam post obitum resectam secum Wittebergam attulit D. Flouricke. Erat autem plica quatuor ulnas longa, palmum lata, duosque pollices crassa, sed altero tanto longior foret, ipso referente, nisi magna ejus pars, temporis quo ægra decubuit diuturnitate, squalore & attritu consumpta fuisset.

V. 2. **T**HE plica has been always thought to be a distemper, and to proceed from a fever or convulsions; but from the best information I can get it seems to be the effect of nastiness, in not combing their hair, nor washing their heads; for if it were a real distemper the people of fashion could no more be free from it than the ordinary and poor, among whom only it happens. This is confirmed by the following article translated from the transactions of Breslaw for August 1724.

“ The great multitude of people in Poland who are troubled with this plica first made me reflect whether it were a real disease or no.

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A a

“ But

An extraordinary instance of the plica Polonica. By Dr. Abr. Vater. n. 417. p. 50. Jan. &c. 1731.

Of the cause of the plica Polonica. By Sir Conrad Sprengell. ibid. p. 51.

" But I am now convinced that their swinish way of living, and the
 " common opinion so deeply rooted in the generality of them that
 " this lock of hair cannot be taken off without danger of their
 " lives, contribute more to this complaint than any real indisposition
 " of body; considering that it is the middling or poor sort only
 " who are troubled with it; whom then one cannot look on with-
 " out horror: but no German, of whom great numbers live in that
 " country, ever had any such thing. Many of them, who are mar-
 " ried to Polish women, are scarce able to persuade their wives not
 " to train up their children in this nastiness. Not long since I saw a
 " fellow at church, with about seventy such locks hanging down
 " from his head, which were as hard twisted as so many penny cords;
 " that one might easily have taken his for a Medusa's head; and who
 " knows but that in antient times such locks as these may have gi-
 " ven rise to the poetical fiction of snakes growing on the head in-
 " stead of hair? Be that as it will it is certainly a most odious sight."

C H A P. IV.

AFFECTIONS of the NECK and THORAX.

*An account of
 the operation
 of bronchotomy
 at St. Andrews.
 By Dr. G. Mar-
 tin to Dr.
 W. Græme.
 n. 416. p. 448.
 Nov. &c. 1730.*

I. 1. **A** young lad, in such a good state of health as to be then making a visit to some of his companions, was suddenly taken ill with a violent disorder in his throat. Being called I could see nothing amiss, the amygdalæ and other parts in view appearing sound enough, but a little drier than ordinary, without any external tumour about the larynx and no considerable frequency or strength in his pulse. But he had great pain and a dyspnoea, and was incapable of swallowing either liquids or solids; every thing returning forcibly by the mouth and nose when he made an effort to get it over. From all which I reckoned it an angina of one of the worst kinds, and the seat of the disease to be in the larynx and the fibres common to it and the top of the gullet. Notwithstanding repeated bleedings, blistering betwixt his shoulders, cupping, &c. the disease continued so obstinate, and the patient was in such danger of being suffocated, that next day in the afternoon his friends, though very averse to it in the morning, earnestly desired that his windpipe might be pierced; and the poor lad bad us try any experiment to save his life. He had good reason so to do; for otherwise he would probably have been strangled to death in a few hours. We directly set about the operation, and with such success, that in less than four days his breathing being perfectly easy, and his deglutition almost so, we removed the cannula, and left the glottis to do its own office.

In the very cutting, before we got a free aperture into the trachea and the pipe introduced into it, the patient felt some relief, which I thought might be ascribed to the effusion of blood in the operation; a small quantity whereof evacuated so near the part affected could not but make a more considerable revulsion, than a much greater taken at a greater distance, according to the true laws of hydraulics and the observations and practice of the ancients, however disagreeing with Bellini's theory. Whence the judicious Fab. ab Aquapendente^a with very good reason supposed that by the derivation here the patient would be more apt to feel some relief than trouble. Which Julius Guastavinus also made no doubt of in his dispute upon this subject against Aretæus^b. And since there continued a greater flux of blood to the wound while it was suppurating, I reckon the circulation in the muscles of the larynx was with less force than ordinary, and so probably contributed to diminish the strength of his voice, it being for several days after the operation much weaker than usual; which I all along thought was rather owing to this, and his lowness of body by a slender diet, &c. than to any hurt of the recurrent nerves; which being cut, do indeed destroy the voice, but by their deepness are in less hazard than some formerly used to think.

The cannula should not be near so short as is ordinarily proposed in books and chirurgical lectures: for we found that the parts, especially the thyroid gland (which is not so much minded in most of the common descriptions of this operation as it should be) upon cutting soon became so much tumified, that it required a pipe above an inch long to penetrate sufficiently into the aspera arteria; which is more than double Garangeot's allowance of six lines; though he is one of the latest writers, and has communicated to us all the surgery the French are masters of. The leaden pipe which we had prepared not answering the design, that which we made use of was too long and too small, being the common cannula for tapping in the dropsy, flattened a little at the end, and hindered by a very thick compress, perforated in the middle, from penetrating too deep into the trachea.

The mucous particles and steams arising from the lungs occasioned a constant weeping of a thin liquor from the mouth of the pipe, part whereof thickening and stuffing its cavity sometimes very much incommoded the patient's respiration by it, so as to render it necessary to have it taken out and cleaned. And hence, when some moderns bid us put a thin slice of sponge, or a bit of muslin, &c. close to the orifice of the cannula, to prevent the ingress of dust, downs, or the like, into the lungs, it confirms what I said before of the unusualness of the operation. I cannot but think it an ingenious proposal of one of our ministers here, to make the pipe double, or one within another; that the innermost might safely and easily be taken

^a P. 480.^b See M. Aur. Severin. p. 1032

out and cleaned when necessary, without any molestation to the patient: for it is no small trouble to him to be obliged to have the bandage frequently removed, and the pipe fitted a-new to the orifice made in the trachea. And indeed we found no inconvenience in our patient's breathing the air as it passed through the pipe without any cleansing or intercepting medium, though the house was none of the cleanest, being an ordinary tradesman's. But if by a larger tube the patient should be incommoded that way, I think the access of dust, &c. might conveniently enough be hindered by a piece of muslin or thin hair-crape tied slackly about the neck over the orifice of the cannula, so as not to touch it or be wetted by the liquor coming from it.

Our patient recovered perfectly in a short time; he breathes, speaks, eats, drinks, performs all the other offices of life, and goes about his calling as formerly. And now I cannot but take notice of the needless pain some writers are in about healing up the wound by bandaging, stitching, &c. for we found it filled up of itself in a very few days, by only dressing it every other day with a soft tent, made less and less each dressing, and armed in the common way with liniment. Arcæi. I believe indeed it would have taken a little more time to heal, if our patient had been older.

*The history of
the operation
of bronchoto-
my. By the
same to the
same. ibid.*

L. 2. **A**ccording to Cælius Aurelianus ^e and the author of the liber introductorius ^d ascribed to Galen, bronchotomy was proposed by Asclepiades (however inconsistent with his delicacy, and the rest of his character, the seeming harshness of this operation may appear) and is described and earnestly recommended by almost all the systematical writers of surgery from Paulus of Ægina ^e, and, as he says, Antyllus, and some others of the best surgeons before him, down to the present times. But when they are at so much pains to defend the reasonableness of it, and when they shew so much fondness of citing and telling examples of the healing accidental wounds of the trachea, without ever mentioning their own regular performance of the operation (which would have been a shorter and much more effectual recommendation of it) when, I say, I consider all this, I find myself obliged to think that it has very seldom been reduced to practice. So rare was it that Aretæus, a man of vast judgment and skill in diseases ^f, thought the operation had never been actually done with success. And Cælius Aurelianus looked on it as an impracticable whim of Asclepiades. Neither Avenzoar ^g nor Albucasis ^h knew any of their countrymen who had undertaken it; and the Arabians are reputed to have been bold surgeons enough. The most that I can find amongst them is in Avenzoar, who tried the experiment on a goat, and cured the wound; for as to what some writers tell us,

^e Acut. iii. iv.

^d Cap. 13.

^e De re medic. vi. 33.

^f Cur. Acut. i. 7.

^g Medic. i. x. 14.

^h Chirurg. ii. 43.

that Rasesⁱ saw Andrusius the physician do it^k, I think this flows from a mistake of that author's meaning. For if you read the whole context, you may easily perceive that all he says of the operation is upon hearsay; and consequently that he had only read that such a one had done it. That most accomplished anatomist and surgeon Fabricius ab Aquapendente^l frankly acknowledges that neither he nor any of his contemporaries had ever ventured to perform it. Neither does his successor in the profession of surgery and rival in anatomy, Julius Casserius of Placentia^m pretend to have done it, tho' he has endeavoured to illustrate the operation by some very neat figures; which you will not readily suspect to be from any but dead bodies. And next to him M. Aurelianus Severinusⁿ who was a very judicious and learned man and the best and boldest surgeon of his time, tho' he recommends it with a great deal of warmth and keenness, yet it seems even in his latter days he never had occasion to try it: so that the first undoubted and distinctly recorded history I can find of this operation being actually practised, is in the learned Anton. Musa Brasavolus^o who performed it in a desperate squinancy when the surgeon refused to do it, and repeated it again in the like case. Mr. Arnaud did it; but his patient died^p. However, his countryman Mr. Binard had better success^q. Dr. Freind^r cites Purman doing it: and^s tells us of another case communicated to him by a surgeon whom he does not name. Besides these, I believe there are but few instances can be produced of any who really performed the operation on a living person. I hear now that Mr. Baxter a surgeon in Coupar of Fife, not far from us, and Dr. Oliphant of Gask in Perthshire, did it with very good success within these few years.

II. 1. **D**ecember 15, 1726. at ten at night I was sent for to an officer of the excise in this town aged near fifty, who was taken with so violent a flux of blood that in a short space of time he lost near three pounds. By the time I came it was pretty well over, only he seem'd to have something, when he cough'd, that stuck in the passage, which by its rattling I thought very loose. I ordered what I thought proper and left him. Next morning they told me, that half an hour after I was gone he had coughed up what they shewed me on a sheet of paper. Upon putting it into water I found it to be a polypus; and, as I think, a very remarkable one. I have sent you an exact draught of it by a painter. I could find by my blow-pipe that it was hollow; but its being torn off with such violence has made so many holes in it, that it cannot be blown up. You will, I believe, conclude that it lin'd the bronchia, that the air had

*A Polypus**coughed up**from the**windpipe. By**Dr. Samber ta**Dr. Jurin.**n. 398. p. 262.**Apr. &c. 1727.*

Fig. 7f

ⁱ Contin. vii. fol. m. 77.^k The copy I looked into, printed at Venice 1505, calls him Ancilifius: and perhaps it should be Antyllus.^l Operat. chirurg. xlii.^m De voc. org. i. 20. ⁿ Chirurg. effic. ii. 40. ^o Com. in^p Hippocr. de diat. in acut. iv. 35. ^q See Garengéot operat. chirurg. xxxi. p. 489.^r Garengéot ibid. xxxii. p. 498. ^s Hist. phys. I. p. 206. ^t P. 207.

a passage

a passage through it, and that a violent fit of coughing having separated the adhesion brought on that violent flux of blood, &c. He had been tormented with a cough for more than six months and was a gouty man; but after this came away, so large an ulcer being made, he had all the successive symptoms of a fatal consumption; as cough, spitting, hectic, colliquative sweats, diarrhoea, and in a month died.

A Polypus resembling a branch of the pulmonary vein coughed up by an asthmatic person. By Dr. F. Nicholls to Sir Hans Sloane Bar. n. 419. p. 123. June 1731.

II. 2. **N**. Tulpius, in Book II. Obs. 7. presents us with the case of a man who, with a large effusion of blood, threw up by coughing two branches of the pulmonary vein six inches long, with their several ramifications, freed from the trachæa and substance of the lungs as if dissected by the most accurate anatomist. This case he observes to be very extraordinary, and not to be paralleled in the writings of physical authors. A little acquaintance with the structure of the lungs sufficiently evinces the impossibility of the fact, as there stated; wherefore (not doubting the veracity of the author) I always believed him to be deceived by a polypus of the vein, which might be cough'd up in the manner by him described.

But the following case will give another light to this affair. July the 18th 1730, I was consulted by Mr. — of Black-Friars, on behalf of his brother living in Essex, who was asthmatic and cough'd up phlegm resembling worms; to remedy which I directed a lac ammoniacum with squills; from the use of which he expectorated more easily, but continued still to cough up the same substances.

June 11, 1731. being on the road to London he was seized with a shivering and pleuretic pains; a white tongue, hard and quick pulse, &c. By repeated bleeding his pains decreased, but the cough remained more violent than usual. On examining the expectorated phlegm (which was tinged with blood) I found it fibrous, and when expanded in water exactly resembling the vessels in the lungs. These substances are as tough as the coats of the veins, and (like them) hollow. Mr. — has cough'd up more or less of them every day for seven years; sometimes perfectly white, and sometimes tinged with blood: Notwithstanding which he has had no other complaint, has had a good appetite and colour, and a greater share of fat than any man would choose. The specimen here shewn was expectorated, when I was present, the 16th instant. It nearly resembles the first draught of Tulpius, and is no more than a viscid phlegm, secreted by the relaxed glands of the trachæa, and afterwards concreted by the heat of the part.

Fig. 75.

Two præternatural bony substances found in the thorax. By Mr. W. Giffard to Dr. Ratty. n. 395. p. 152. Aug. 1726.

III. 1. **M**AY 10, 1726, I opened the body of a person who dy'd the foregoing day of a peripneumonia; in the right side of whose thorax I found an osseous substance about the fourth of an inch, six inches long, and three broad, extending it self under the third, fourth, fifth and sixth ribs, closely and strongly connected to the periosteum of the ribs, and the tunica propria of the inner intercostal

costal muscles, by fibres which shot from a strong and thick intervening membrane that closely adhered to its outer surface or back, and was continued over its inner likewise, thereby forming a capsula for this præternatural substance. Its upper edge lay immediately below and was contiguous to that part of the ribs where they become cartilaginous: the membrane that adher'd to and cover'd it continued thick some distance from it, and gradually grew thinner till it was at length lost in the pleura; from whence I judged this extraneous body to have been formed between the two lamellæ of that membrane. The lungs so strongly adhered to its inside that upon separating them part stuck to it: upon cutting into which I observed all the cells stuffed with a thin but somewhat digested pus. Upon farther enquiry I found on the same side towards the back another substance, but perfectly bone, invested as the former with a strong and thick membrane, and by the fibres which shot from it tied to the body of the vertebræ and the fourth, fifth, sixth and seventh ribs, and intercostal muscles. Its back or outside was convex, answering to the concave surface of the ribs which had made indentations on that part of it where they press'd: its inside was concave as the ribs; the right lobe of the lungs strongly adhered to it, part of which for that reason remained sticking to it after separation: its length was about seven inches, its breadth about three from edge to edge, its thickness in some parts a third, in others a fourth of an inch. It had, as the former, a thick membrane running from it, which gradually thinning was at length lost in the pleura; whence I judge this extraneous substance to have been formed as the forementioned.

III. 2. **H**E was troubled for some years with a short cough, which latterly was accompanied with a difficulty of breathing and great labour in inspiration, and some time after with a weight and pain on the right side; which symptoms encreasing more and more brought on the peripneumonia of which he died in a few days. The rise and succession of these different symptoms proceed naturally from the formation and growth of the præternatural bodies above described.

IV. **T**HE matter in question is, whether the lungs cool and condense the blood, according to the antients, or whether they mix, attenuate, and of consequence expand it, according to Dr. Pitcairn.

M. Helvetius, in a treatise he has lately written to support the opinion of the antients, brings several arguments to confute the system of Dr. Pitcairn: the most considerable whereof, and which indeed he makes his argumentum crucis, is, that the right auricle and ventricle being considerably larger than the left auricle and ventricle, and the pulmonary artery having a larger capacity than the pulmonary vein, the blood must necessarily occupy a greater space before than after its passage thro' the lungs; and because the difference in the capacity

A further account of the same case. By Dr. W. Rutty. ibid.

Concerning the use of the lungs. By Dr. F. Nicholls. n. 410. p. 163. July &c. 1729.

capacity of these vessels cannot be ballanced by any increase of the velocity, he concludes that the blood is not attenuated and expanded, but must be condensed in its passage through the lungs. And this he conceives is done by the air, which being relatively cold, and so intimately applied to the blood in the action of inspiration, must cool and condense it.

That the blood is cooled by the action of inspiration is a matter of which I believe few physicians can doubt, when they consider that in inflammations of the lungs nothing is more earnestly desired than the breathing cool and fresh air, nor does any thing more evidently conduce to the cure of all inflammatory dispositions. But if we consider the state of the blood at its return to the heart, and how careful nature has been not to use this blood for the nourishment of the lungs before it has passed through the pulmonary vein and artery (though it would have been as effectually cooled in the bronchial arteries as in the pulmonary vessels) we are naturally led to believe that it has some other quality besides its heat which renders it improper for nourishment, and which must therefore be destroyed by the action of the lungs. For this reason, and from considering the structure of the parts subservient to breathing, it seems evident that the blood is mixed, attenuated, and consequently re-expanded in the action of expiration. I shall now consider whether the action of inspiration so far over-balances that of expiration, as to condense the blood into a less bulk than it had before its passage through the lungs.

The accurate Santorini of Venice †, has carefully examined the fact as stated by Helvetius; and finding it true in that one subject as to the auricles and pulmonary vessels, but false as to the ventricles, he proceeds to prove that this difference in the capacity of the pulmonary vessels could not be designed on account of the blood's being condensed in its passage through the lungs; because, if so, the right ventricle ought to have been larger than the left ventricle, and the pulmonary artery ought not only to have been larger than the pulmonary veins, but also larger than, or at least equal to, the two venæ cavæ; whereas in his subject the two venæ cavæ were to the pulmonary artery as 228 to 188. In the mean time he recommends the same enquiry to other anatomists, as doubting whether the fact is constantly so in healthy subjects. As such an enquiry may be of consequence, not only in settling the point in question but in explaining other parts of the animal œconomy, I doubt not but it will be agreeable to the society; and the rather, because the subjects from which I have taken the several calculations are here produced before the society, and submitted to a re-examination if desired.

The measure I used is the 113th part of an inch. I have taken the triple of the diameter for the periphery, and computed the area by multiplying the nearest whole number to $\frac{1}{3}$ of the diameter into the

† Observ. ch. 8. §. 3.

periphery. Though this method is not geometrically exact, yet as my design was only to find nearly the relative contents of the several vessels, I chose it to avoid embarrassing the sums with fractions.

The first heart is of an adult in which

The Diam. Per. & Areas are

Of the Vena cava descendens	79	237	4740	
Pulmonary artery	115	345	10005	
Superior left pulm. vein	69	207	3519	} 12477
Inferior left pulm. vein	73	219	3942	
Superior right pulm. vein	49	147	1764	
Middle right pulm. vein	40	120	1200	
Inferior right pulm. vein	57	171	2052	
Aorta	110	330	8910	

The ascending cava being tied above the diaphragm, could not be measured in this subject.

As Helvetius does not mention the disease of which his subject died, I cannot say how proper it was for the purpose; but it is evident his observation does not tally with the calculations made from this first heart; where the pulmonary artery is to the sum of all the pulmonary veins as 10005 to 12477. And yet this subject (besides a cancerated ovary, and a putrefaction of the right kidney from the ureter's being compressed) had the lungs full of small tubercles, and the glands lying between the great divisions of the trachæa almost petrified by atheromatous concretions: by all which it is highly probable that the passage of the blood through the lungs was very much impeded, and of consequence the pulmonary artery much dilated beyond its natural capacity. And this I am the rather induced to believe from examining the second heart, which is of a child near twelve months old. As to its death, I can say nothing more than that its lungs appeared perfectly sound and of a pale clear colour; and therefore the more proper for an examination of this kind.

In this second heart the Diam. Per. & Areas are,

Of the Aorta above the coronaries	43	129	1419	
Pulmonary artery	43	129	1419	
Superior left pulm. vein	29	87	609	} 2088
Inferior left pulm. vein				
Superior right pulm. vein	26	78	507	
Middle right pulm. vein	17	51	204	
Inferior right pulm. vein	32	96	768	

We may here observe that the aorta, after giving off the coronary vessels, is equal to the pulmonary artery. As to the proportion between the pulmonary artery and veins, the artery in this subject is to the sum of all the veins here measured as 1419 to 2088, and yet the lower left pulmonary vein is here omitted, being tied too close to be measured. But if we suppose the inferior left pulmonary vein to be to the superior left pulmonary vein in the same proportion as in the

first heart, we shall then find its diameter nearly 31, and its area at least 700, which will make the pulmonary artery in this heart; to the sum of all the pulmonary veins as 1419 to 2788; and in that case, the left pulmonary veins will be to the right pulmonary veins but as 1309 to 1479.

The 3d heart is of an abortive of about five months: from its appearance I judged it suffocated by too much blood.

In this subject the

	Diam. Per. Areas are,		
Of the Vena cava descendens	14	42	197
Vena cava ascendens	24	72	432
Aorta above the coronaries	16	48	192
Pulmonary artery	20	60	300
Canalis arteriosus	12	36	108
Right pulmonary artery	11	33	99
Left pulmonary artery	11	33	99
Superior left pulm. vein	11	33	99
Inferior left pulm. vein	9	27	54
Superior right pulm. vein	7	21	42
Middle right pulm. vein	11	33	99

} 629

} 198

} 294

The inferior right pulmonary vein is here cut too close and other-ways injured, so that its area cannot be measured. Nevertheless we find the remaining pulmonary veins to the pulmonary branches of the pulmonary artery as 294 to 198.

We may here observe a remarkable difference between the capacities of the two venæ cavæ taken together, and the pulmonary artery; the two cavæ being more than double the pulmonary artery, and the pulmonary artery still one third larger than the aorta. As this difference could not arise in this case from the blood's being condensed by the inspired air, it seems to prove that had the fact been constantly true as stated by Helvetius, it had nevertheless been an insufficient demonstration of his system.

*Of the palpi-
tation of the
diaphragm.
By Mr. Ant.
Leeuwen-
hoek. n. 377.
p. 342. May
&c. 1723.*

V. 1. **H**AUD ita pridem vehementi circa diaphragma motu correptus sum; adeo quidem ut adstantes non parum turbarentur. Cum morbi illius nomen exquirerem, medicus cordis esse palpitationem respondit. Ego illum falli censebam; licet enim, durante motu, pulsum arteriæ sæpius manu explorarem, nullam pulsus accelerationem percepi. Vehemens ille motus per intervalla recrudescens tres circiter dies duravit; quo tempore stomachus mihi & intestina in officio motuque cessabant; mortemque præ foribus esse certissime credebam. Ego vero obstructionem in diaphragmate hæc-rere judicabam, non minorem nummo imperiali.

*The structure
of the dia-
phragm. By
the same.
n. 379. p. 400.
Sep. &c. 1723.*

V. 2. **U**T autem de hac affectione omnem mihi dubitationem eximerem, diaphragma ovis anniculæ ad me deferendum curavi, partemque illius in minuta frustula confectam ope microscopii qua potui diligentia consideravi; comperique illud ex parte compositum esse ex tenuissimis fibrillis; quæ sine microscopio conspectæ latum

larum circiter capillum inter se distabant. Cum deinde diversa frustra diversis microscopiis applicuisssem & visu diligenter examinasssem, pro certo statui fibrillas illas ex partibus exoriri carnosas quæ diaphragmati circa costas intexuntur, easque vice tendinum illi inservire. Tendines isti, sic mihi dicti, non sunt per totum diaphragma æque sibi vicini: quin alii aliis, quamvis sibi vicinis, sunt aliquanto crassiores. Cum autem & fibrillas modo dictas & membranam inter fibrillas exporrectam rite considerasssem, animadverti diaphragma, quantum ad maximam sui partem, ex fibrillis istis & membrana fibrillis interjecta compositum esse: si modo vasorum sanguineorum & copiosi adipis, quæ diaphragmati magna copia insident, rationem non habeamus. Membrana vero inter tendines interjecta tot rugulis exiguisve plicis scatebat ut pene obstupescerem: istas autem rugas sive plicas ad hunc usum naturaliter destinatas esse credebam ut diaphragma per aëris inspirationem extensum rursus contraherent; eaque ratione opem suam conferrent ad aërem, qui pulmones per inspirationem impleverat, inde expellendum. Ut diaphragmatis contexturam oculis spectandum exponerem exiguum ejus portionem delineari curavi. In icone 76, BG, CF, & DE tres sunt tendines ea magnitudine expressi quam microscopium oculis exhibebat. Ut autem de vera iconis magnitudine judicari possit, delineatorem ut veram frustuli delineati magnitudinem digito indicaret rogavi; qui mox spatium inter YZ in icone 77 demonstravit. Adhæc membranam modo dictam per multis iisque exiguissimis foraminibus pertusam esse observavi, quæ ab abdomine patebant in pectus, & a pectore vicissim in abdomen. Cum autem fieri non posse hæcenus judicaverim ut humor quispiam ex pectore delabatur in abdomen, vel ex abdomine subvehatur in pectus, nunc satius mihi videtur judicium super ea re meum suspendere; forte etiam pulmonibus nostris vascula insunt incomprehensibilis exilitatis: quippe si cogitemus quantum humoris ex pulmonibus nostris per expirationem educatur in aërem, præ exigua humoris copia quam inspirando ex aëre inferimus in pulmones, facile in sententiam illam propendebimus. Sed & hoc non semel observavi quod fibrillas illas quas tendines appello vasa quædam perrepant itinere transverso. In alio ejusdem diaphragmatis frustulo, quod microscopio applicatum servabam, clare intueri licebat structuram exortumque membranularum quas inter fibrillas sive tendines interjacere dixi. Membranulas illas permagno plicarum numero instructas videmus: quæ omnia in icone 78 exhibentur ad LK. Fibrillæ vero designantur per LMNOPQ: hic autem majores sunt quam uspiam mihi occurrerint. Præterea membranam illam ex qua diaphragma maximam partem constare dixi, quamvis tam tenuem, a se divelli, & exiguum avulsæ partis portionem ope microscopii in icone 79 expremendam curavi. Quod eo consilio feci ut laceros tendines atque membranulas, quantum ars imitari naturam poterat, oculis subicerem. Ergo hic per RSTV particula indicatur tendinis extensi;

Fig. 76.

Fig. 77.

Fig. 78.

Fig. 79.

ubi & exilissimæ exhibentur fibrillæ ex quibus contexta est: per VT & WX portio designatur tendinis quiescentis. Istud vero neque explicari neque satis comprehendi potest, quam incredibilis fibrillarum, vasculorum, & particularum numerus hic inter se conglomeretur; & ad tenuissimæ membranæ, diaphragmatis inquam, formationem concurrat. Sic autem statuo, quoties validius inspiramus omnes illas plicas sive sinuosas corrugationes in diaphragmate evanescere atque complanari: quoties autem expiramus diaphragma rursus in plicas rugasve contrahi. Dum igitur tantam adipis copiam in diaphragmate gigni & congregari videmus; prætereaque cogitamus substantiam illius per adipem illum sic utrimque posse crassescere ut in tumorem extuberet; facile intelligemus illius expansionem atque contractionem ea ratione posse impediri atque pigrescere, atque hinc spirandi difficultatem consequi: ob quam rationem homines obesos præ aliis anhelos esse judicamus. Modico autem adipe diaphragma perfundi oblique necessarium statuimus: cum enim singulis horis nongenties expandatur, nongenties contrahatur, motus illos per adipem magnopere adjuvari censemus. Cæterum frequentiori indagatione explorare conatus sum qua ratione carneæ diaphragmatis partes, quas costis vicinas esse dixi, transiissent in membranam; sive qua ratione membrana diaphragmatis ex illis esset exorta. Verum licet indagationem illam crebro repeterem ipse mihi satisfacere non potui. Jam & dubitatione subierat an tendines vasculis sint instructi: & licet microscopio meo vix tantum tribuere auderem tamen tertio post die indagationem iteravi & tendines transverse dissecuri: indagationem meam illuc dirigens ut etiam in membrana diaphragmatis quam rugosam esse dixi sanguinea vasa requirerem. Tandem igitur successit ut sanguinea vasa secundum longitudinem tendinum protendi, imo octonos denosque invicem adjacere viderem. Inde ad membranam quæ tendines quasi circumvestit oculos converti; in eaque tam ingentem observavi numerum exilissimorum vasculorum ut admiratione defixus hærerem. Complura istorum vasculorum velut areolis inclusa jacebant; quæ tendinum transverse perfectorum vascula esse censebam. Ut autem horum omnium testem haberem ocularem, microscopium cui dictas diaphragmatis particulas applicaveram chirurgo meo tradidi; qui dicta mea cum iis quæ videbat adamussim convenire respondit.

Hac tamen observatione non contentus comparavi diaphragma bovillum; ex quo circa partes illius carneas, quas costis adjaere dixi, frustum circiter palmarium excidi: comperi quoque diaphragma bovillum circiter quadruplo crassius esse ovillo; & hanc crassitudinem maxima ex parte illius adipi acceptam esse referendam. Exinde ex illa diaphragmatis portione lamellam quam potui tenuissimam abscidi; quoties enim paulo crassiorem excindebam persecabam adipem qui versus medium diaphragmatis protenditur; puta, ubi diaphragma satis est crassum neque adipis expers. Diaphragma vero utrimque, i. e. superius atque inferius, quatuor distinctis constat membranarumque

earumque tendinibus, qui membranis velut inclusi delitescunt. Istorum autem tendinum ingens multitudo non poterat mihi non admirationem parere: neque satis credibile videbatur in corpore, cujus structura functionesque tam parum sunt cognitæ, tales tamque multiplices partes includi. Ut diaphragmatis bovilli structuram oculis exponerem partem illius ad ABCD in icone 80 exprimendam curavi, Fig. 80. ubi primo quatuor exhibentur partes distinctorum tendinum, qui magno numero invicem adjacent & supra in diaphragmate ovillo etiam sunt exhibiti. Verum per integrum bovis diaphragma istiusmodi diffunduntur exiguissimi tendines. Et hos una cum membranis necesse est in rite constituto corpore sine ulla intermissione alternatim extendi atque contrahi. Tenuissimas illas fibrillas, uti & membranarum rugulas plicasve, per crebram indagationem etiam ex voto meo deprehendi in diaphragmate ovillo; nec ipse tantum sæpius cum voluptate consideravi sed & aliis considerandas exhibui. Cæterum tendines illos & tenuissimas particulas transverse persecuti; inquirere volens num forte sint perviæ & cavitatibus præditæ. Quando incredibilis exilitatis vascula tanto numero in oculos meos incurrerunt ut qui ipse non viderit vix mihi sit habiturus fidem. Tum & ingentem percepi numerum exiguissimorum vasculorum quæ transverso diaphragma itinere permeabant; & quantum ego quidem sentiebam, ad hoc officium a natura destinantur ut adipem per omnes diaphragmatis partes circumferant, & ipsi diaphragmati continuum alimentum subministrant. Superius modo dixi adipem in diaphragmate inclusum latere; & utrimque super adipem quatuor exporrigi membranas inter se omnino distinctas. Addo membranas istas tam arcte sibi conjunctas esse ut simplex esse membrana videatur. Jam vero alteri microscopio, quod paulo minus quam microscopia modo dicta magnitudinem objectorum augebat, frustum diaphragmatis mediocris crassitudinis admoveram. Quod eo spectabat ut demonstrarem qua ratione membranæ partes diaphragmatis adiposas, sive ipsum diaphragmatis adipem, utrimque circumdant; adeo ut adeps in membranis illis includi videatur. Id autem in icone 81 indicatur per EFGHIKLM, ubi per EFGH, Fig. 81. item per IKLM, duæ istæ quadruplices designantur membranæ; in GH vero, & IK, adeps sæpe jam dictus includitur. Cum deinde tenuissimam diaphragmatis portionem in orbes conscindere conarer, diaphragma in duas partes sive lamellas secessit; unde suspicatus sum diaphragma sic a natura comparatum esse ut adeps eo facilius per ejus substantiam distribuatur. In icone 80, ubi membranæ transverse sectæ exhibentur, quædam exiguæ apparent corrugationes quas in iis plerumque percepi. Postea comperi membranulas in quibus adeps coeundo producitur exilissimis vasculis annexas esse; quæ tamen vascula per contiguarum partium exsiccationem in diaphragmate jam dicto erant disrupta. Hanc ego membranularum & vasculorum connexionem necessariam existimo, ne diaphragma quoties extenditur omnino complanetur, sed in cavitatem pene globosam sese expandat. Forte complures

Fig. 82.

complures diaphragma sentient esse membranam apprimè crassam; cum tamen sit membrana perexilis. Ut igitur hunc illis errorem examinam frustulum diaphragmatis bovilli sicut se nudis oculis offert delineandum curavi: istud tamen verum est, diaphragma pro tenuitate sua esse oppido robustum, quod multitudini exilissimorum tendinum tribuendum esse statuo. Per NOPQ in icone 82 frustulum designatur diaphragmatis bovilli: ubi per fibrillam NO unum latus, sive dimidia ejus crassitudo indicatur; per PQ altera crassitudinis illius medietas exprimitur. Quidquid inter OP & NQ interclusum est adipe sive partibus adipolis est oblitum: nisi quod inter NQ non-nihil carnis interjaceat, pertinens ad carnem costis adjacentem.

Igitur medicos errare cogito dum palpitationem quam in pectoris regione quandoque percipimus cordis palpitationem appellant. Certe ego illam ex mala diaphragmatis affectione oriri censeo; sive in causa sit alimenti defectus, sive vasorum quæ diaphragma magno numero pervagantur obstipatio. Talis enim obstipatio in ante-dictis tendinibus facile convulsivos motus excitare potest.

Of the use of
the dia-
phragm. By
the same to
Dr. Jurin.
n. 380. p. 438.
Nov. &c.
1723.

V. 3. **M**Ultis ab hinc annis pro certo habui quod diaphragma totum abdomen continue moveat, quo motu cibi in ventriculo & intestinis conteruntur & in materiam tam fluidam redigantur ut intret parvula illa vascula sanguinea quæ multa in intestinorum cavitatibus sita sunt: non autem per oscula illorum vasculorum, ut quidam hominibus persuadere conati sunt, sed me judice per tenues tunicas illorum parvissimorum vasculorum sanguineorum. Si jam ponamus arteriam in corpore bene constituto intra horæ unius spatium ter millies & sexcenties pulsare, quatuorque pulsus fieri in una respiratione, computabimus nongentas respirationes spatio unius horæ, ac toties fiet pressio ventriculi & intestinorum, quam voco subactionem in ventriculo & intestinis contentorum.

Duos abhinc menses varias lentas palpitationes per diaphragma sensi: quare cogitabam de tuba quadam vitrea, à me inventa, ad spiritum cujusdam liquoris in pectus ducendum, ut experimentum facerem num insolitus ille diaphragmatis motus, quem cordis palpitationem vocant, sedari posset. Implevi ergo meam tubam ad altitudinem trium transversorum digitorum spiritu vini, in quo jam diu hæc aromata fuerant infusa, nempe nuces moschatae, macis, & parum garyophyllorum, sed cinnamomi multum, ut & croci, & inspiravi aërem transeuntem per hunc spiritum vini, & quidem non modeste sed fortiter aërem in pulmonem impulsi, quo diaphragma, quod fortis membrana est, valde extendebam, experiendi gratia num palpitationem vel inordinatum illius motum hoc facto componere possem; quod illo tempore bene successit: sed postea quidem evenit ut experimentum hoc, quamvis aërem tam fortiter in pectus inducerem ut pressus aer cum tussi ex gutture erumperet, expectationem meam eluserit.

C H A P. V.

AFFECTIONS of the ABDOMEN.

I. J. Skidmore had complained for three or four years last past of a violent pain in his stomach and bowels, never being able to rest in his bed at night till he had vomited up the greatest part of what he had eat or drank the day before. He would often compare his pain to a great weight lying upon the region of the stomach, which he in some measure alleviated by pressing hard with his hand upon the part. When he turned himself in bed from one side to the other, he told me he could plainly perceive some fluid fall down with noise to the lower side; which fluid he believed to be the occasion of all his misery, and often earnestly press'd that the surgeons would cut him open (as he expressed it) and let it out. He had no apparent tumour upon the part, nor was his belly more distended than usual. He had had the advice of several able physicians before he came into the hospital, but all without the least amendment to his disease. When he died we were desired to open him and try if we could find out the cause of his complaints. As soon as we had penetrated the peritonæum there flowed out a whitish liquor, not much unlike to whey, only a little more thick and fæculent; nor did it emit so noisom a smell as might be expected from its long residence in that place. We judged there were above four quarts of this liquor in the cavity of the abdomen. The stomach we found perforated in its upper part, about the middle space betwixt the two orifices, wide enough to admit the end of one's finger. We cut it open length-ways and found it pretty full of a thick glutinous matter inclining to yellow; and to its inner coat on the lower side there firmly adher'd the stone of a prune, or some such fruit; its inside near the præternatural perforation was gangren'd for two or three inches; and on the other side of the perforation there was an ulcer near the same bigness. The whole stomach was a great deal thicker than usual; but that part next the pylorus was above four times thicker than in a natural state. It adher'd closely to all the parts about it; and to the pancreas 'twas so firmly ty'd down that it could not be separated without tearing. The spleen did not exceed a quarter of an ounce in weight. The pancreas was schirrous, tho' pretty near its natural size. In the liver and kidneys there was no apparent defect; nor had the parts in the thorax suffered any visible alteration, except that the lungs adher'd more firmly to the pleura than usual. The intestines and all the viscera contained in the abdomen were whiter than usual, by being so long sodden in the abovementioned liquor.

A præternatural perforation in the upper part of the stomach.
By Mr. Chr. Rawlinson.
n. 400. p. 361.
Nov. 1727.

*Two cases of
wounds in the
stomach cured.
By the Rev.
Mr. James
Field to Mr.
J. Douglas.
n. 371. p. 78.
Apr. &c. 1722.*

I. 2. **A** lusty young negro man returning home about noon went into his house, where seeing some ripe plantains he eat of them heartily; his father in law, about sixty years of age, coming home soon after, and finding the young fellow had eat up his fruit, pulled out his knife and gave him a desperate wound in the upper region of the belly, a vast gash being made in the stomach, insomuch that the plantains which he had eaten burst out through the wound. The old man immediately fled for it, and the young fellow's companions hearing what was done pursued him: perceiving them get ground of him, and suspecting their design was to kill him, he pull'd out the same knife with which he had stabbed the other, and gave himself a desperate wound also in the upper region of the belly, his stomach being likewise seen; only with this difference, that this last wound was transverse or from left to right, the first directly up and down; the old fellow was carried home and laid in the same house where the other lay. This happened about noon, and Mr. Forrest the surgeon came not to dress them till between four and five; he stitch'd up both their stomachs entirely, and their bellies too except only a small hole for suppuration; a fever seized each of them and held them about a fortnight, the wounds were brought to a good digestion, and in about a month's time the young fellow went abroad, but the old man who was in most danger lay something longer; however, they were both perfectly cured, and have been very well ever since, tho' it is above fifteen years ago.

*An imposthu-
mation in the
stomach cured.
By Mr. Atkin-
son to the
same. n. 371.
p. 80. Apr. &c.
1722.*

I. 3. **I** had a patient about seven years ago, who had a large tumour on the upper part of her belly; it was hard and painful, but did not alter the natural colour of the skin, and had been three months a coming. I applied a warm gum plaister to it, which in a fortnight's time brought it to suppuration. I then applied a caustic about the bigness of a shilling; when the eschar fell off, seeing a solid kind of substance appear in the orifice, I laid hold of it with my forceps and pulled it gently towards me, upon which there thrust forcibly out such a quantity of it as almost filled my hand; so I dress'd it. Next dressing the same substance appear'd again, which on her straining forced out near twice as much as before. I was at a great loss to determine what this was, but at last concluded it to be the omentum itself, in which opinion I was confirm'd by some other surgeons to whom I shew'd it. I was still in doubt whether or no the stomach were concerned in this case till the next removal of the dressings, at which there spurted out in a full stream above half a pint of ale, which she had drunk a little while before. I now concluded the case mortal; however I ordered her to keep her bed, to lie constantly upon her back, and feed on things of easy digestion. The greatest part of what she eat or drank came thro' the ulcer for eight or ten days, so that I had no hopes of her; yet contrary to my expectation she was perfectly cured in about six weeks, and is now living and in good health.

II. **A** patient of mine having died lately of an imposthumation in his liver, I open'd him and out of the lowest and thinnest lobes took six quarts of purulent, thick, most intolerably foetid, reddish-brown matter; and so acid that as soon as it was exposed to the open air it fermented exceedingly. The patient had drained off the thinner part by violent vomiting and purging to thirty or forty times a day, during the last week of his life; which was caused by the matter's being thrown into the duodenum through the ductus cholidochus communis, and there by its sharpness stimulating the intestines. All the upper part of the liver to about an inch below the gall-bladder was found. The tumour had so compressed the right kidney that it was less than the glandula renalis.

An extraordinary imposthumation of the liver. By Dr. T. Short to Sir H. Sloane Bar. n. 420. p. 184. Aug. 1731.

III. **V**IR quidam G. Deppe annorum xxxiv. castra secutus, anno MDCCVI. in prælio prope Ramellies commisso, ab inflicto in sinistro hypochondrio vulnere, per hos xiv annos magnam portionem intestini coli, ictu hoc secti atque inversi, spithamæ magnitudine e corpore prominentem gerit. Intestinum hoc, vulnere in illud etiam penetrante, interiorem superficiem ad exteriora vertit, & ita in medio cohærens duas portiones efformat, quarum altera versus superiora extensa orificium monstrat, quod ad intestina tenuia spectat, & fæces alvinas educit; altera vero portio ad inferiora propendens orificium ad rectum apertum habet, ita ut clysterem per idem injectum reddat per anum. In interiori superficie nunc ad extra vergente glandulæ apparent copiosissimæ, albi ac cinerei coloris, verrucarum instar eminentes & jucundissimum spectaculum exhibentes, quæ inclementius tactæ sanguinem fundunt. Intestinum ita prominens nunquam totum regreditur intra abdomen, ventriculo tamen vacuo quodammodo regreditur, sed cibo assumpto longius protrahitur, imprimis spiritu retento. Utitur vir ille aqua gelidissima, imo glacie ac nive permixta, ad abstergendas fordes, sine ullo incommodi sensu; fert etiam intestinum aerem frigidissimum, a quo tamen intra se retrahitur & indurescit, ac quodammodo pallescit. Cibos omnis generis perferre potest vir iste; fructus tamen recentes & olera cibus reliquis non miscentur, sed indigesta exeunt, quemadmodum & jufcula sine solidis cibus assumpta.

Part of the Colon hanging out through a wound for fourteen years. By Dr. Abr. Vater. n. 366. p. 89. Sep. 1720.

Fig. 83. A. B. C. D. Intestinum colon inversum, ex vulnere prominens, & versus superiora & inferiora porrectum.

- a. Orificium superius ad intestina tenuia patens, per quod exeunt fæces alvinæ.
- b. Orificium inferius, quod ducit ad rectum & clysterem per idem infusum per anum reddit.
- c. d. Vestigia vulneris à chirurgo ampliati; per cujus medium adhuc apertum intestinum prominet.
- e. Umbilicus.
- f. f. f. Glandulæ copiosissimæ.
- g. Regio inguinalis.

h. h. Dorsum.

i. Coxendix.

K. Regio lumbaris.

*The dissection
of a woman
who had a
large umbilical
rupture.
By J. Ranby
Esq; n. 421.
p. 221. O.E.
Sc. 1731.*

IV. **A** Bout six years ago her husband gave her a kick on the belly ; and from that time she complained of pain and a swelling about the navel, which gradually encreased to near the size of a man's head, seldom giving her any uneasiness but by its weight, and that chiefly when her bandage was off ; for she generally wore one, except when some accident brought on a diarrhoea, which was always attended with cholic pains, particularly in the rupture : to ease these she was advised to apply a hot iron to the part, and had thereby so often burnt it that there remained on the skin several large cicatrices. Three days before her death she was taken with the diarrhoea attended with a slight fever.

On opening the bag the cawl first presented, the greatest part whereof adhered to the peritonæum : on removing this the small guts, to the length of two ells and a half, were contained in the bag, together with all the colon, except so much of it as is below the left kidney ; and the beginning of the colon together with the cœcum were attached to the mesentery, in such a manner as to be but two inches distant from the pylorus ; which with about one third of the stomach, was by this means drawn into the bag. The beginning of the duodenum just entered the bag and then returned out again ; which with a very small portion of the jejunum was the chief that remained in the abdomen.

*A very large
spleen and
small bladder.
By the same.*

*n. 401. p. 414.
Jan. Sc. 1728.*

*An omentum of
a monstrous
size. By Dr.
J. Huxham to
Dr. Jurin.
n. 382. p. 60.
March Sc.
1724.*

V. **A** boy aged ten years was killed by a blow on the skull ; his spleen weighed two pounds, and possessed almost all the left side of the abdominal cavity. The bladder distended to its greatest capacity would not contain an ounce.

VI. **V** Eterani cujusdam militis uxor dolore colico & vomitu diu laboraverat, quibus supervenit ventris tumor durus qui auctus indies magnam in molem excrevit. Jam evomuntur omnia, bilis atra, sincera, tandem & ipsæ fæces alvinæ : dolor vero persæpe immanis in sinistro præsertim hypochondrio. Fetus, cathartica, enemata, anodyna, plurima a pharmacopœio adhibentur ; incassum omnia ; permanet dolor, increscit usque tumor digitorum pressui haud magis cedens quam si lignum esset. Ex hocce tumore plura quasi tubera enata sunt, quorum unum alterumve caput puerile, alia pugnum virilem magnitudinē æquabant : eminebat autem maximum in sinistro hypochondrio, ubi gravissimum sentiebat dolorem, ita ut sæpius exclamaret se illum tumorem cupere perfossam. Increscente tumore facta est valde dyspnoica. Tanta tamque atrocitas per menses fere 14 perpeffa fuerat mulier, cum tandem grata venit mors.

Nudato cadavere montosum observavimus ventrem ; reliquum vero corpus summa macie confectum. Secto abdomine in conspectum se dedit ingens quasi sibi massa (minus tamen alba) totum ventris ca-

vum

vum adimplens, ita ut nec ventriculus, nec jecur, neque intestina apparerent ulla; adhæserat enim omentum hoc enorme peritonæo pluribus in locis, in utroque præsertim hypochondrio, ubi & latior & firmior erat cohærentia. Secto autem in modum crucis peritonæo, & ab omento separato, conspeximus illum in pelvim fere detrusum, omentum etiam toti jecinoris cavo annexum, ventriculum hac mole oppressum, uti & duodenum, colon & jejunum: cum adiposo renum involucrio (sinistro præcipue) connexum & quasi confusum erat; adeo ut colon, altius paulo quam in rectum definit, sebo hocce concreto penitus esset involutum; hinc fæcibus præclusum iter, hinc dolores illi sævissimi quibus ante mortem excruciatâ fuerat mulier: neque enim per plures dies ante mortem vel sua sponte vel clysmatibus acerrimis irritata alvus fæces ullas dejecerat. His lustratis ingens separavimus omentum à jecore, ventriculo, schirroso pancreate, intestinis, tandem & à mesenterio, & ab interna peritonæi lamina renibus instrata. Splen erat hac massa quodam modo demersus, contractior & quasi coriaceus. Pendebat omentum hocce lb̄ xvi ½ avoird. reliquimus tamen unam saltem alteramve libram partibus adhærentem. Pondus hercle maximum! si consideremus ex obesiore homine omentum vix libras pendere tres; majus certe inveni antehac nunquam, quanquam & secui & dissecta vidi plurima hominum cadavera. Factor equidem longe majus à Greg. Horstio in suis observat. memoratum esse, majus etiam in ephemerid. German. ann. x. veruntamen hoc quoque nostrum monstris annumerari merito potest. In extima illius parte, nec non in interiore substantia, plura observavi vasa sanguinea, eaque certe maxime dilatata, quorum aliqua penna anserina majora, aliqua vero quasi in aneurismatibus terminantia. Ex horum aneurismatum maximo uncias circiter sex nigricantis sanguinis extraxi cum quibusdam grumis albidioribus; anne adipis particulæ à venis epiploicis absorptæ atque morbo congelatæ? Ex plurimis lobis conflari mihi videbatur massa hæcce sibi invicem arcte hærentibus; aliquos tamen separavi, quorum pauci pamo minori magnitudine æquales, forma haud ab similes erant. Media hujus pars, cætera durior, cultro haud facile cedebat.

In isthoc cadavere sequentia etiam observatu digniora erant. Inferior hepatis pars in scirrhum abierat. Ex vesica fellea plures exemi calculos, carbonem fossilem colore referentes, friabiles, aquam innatantes; his etiam inerant plurimæ particulæ micantes, haud dubie salinæ. Mesenterii glandulæ schirrosæ erant, imo quædam in substantiam pene lapideam induratæ. Intestina tenuia inflammata erant, colon cum cæco fere totum gangræna correptum, etiam processus ipse vermicularis. Ren uterque sanus satis: dexter autem duos emittebat ureteres, ejusque pelvis etiam duplex erat, & septo quodam divisa digitum transversum crasso, ejusdem perfecte substantiæ cum reliquo renis parenchymate. Erant in imo abdomine feri subcruenti li-

*A dropsy in
the left ovary
cured. By Dr.
R. Houstoun.
n. 381. p. 8.
Jan. &c.
1724.*

bræ quasi duæ. Malum hoc immedicabile prorsus videtur, nisi quis morbi principiis obstitisset.

VII. **I**N August 1701. I was desired to visit one Margaret Millar, a poor woman of 58 years of age, who lived not far from Glasgow, and lay bedrid of an uncommon disease. She inform'd me that her midwife having violently pulled away the burthen in her last lying-in at 45 years old, she was very sensibly affected by a pain which then seiz'd her in the left side between the umbilicus and groin, and had scarce ever been free from it after, it having troubled her more or less during 13 years together; that for two years past she had been extremely uneasy, her belly grew very large, and a difficulty of breathing increased continually upon her; insomuch that for the last six months she could scarce breathe at all without the utmost difficulty. That in all that space of time she had scarce eat so much as would nourish a sucking child, having quite lost her appetite, and that for the three last months she had been forc'd to lie constantly on her back, not daring to move at all to one side or other. This tumour drew towards a point, and was grown to so monstrous a bulk that it engross'd the whole left side from the umbilicus to the pubes, and stretch'd the abdominal muscles to so unequal a degree that I never saw the like. Her lying so long continually on her back having grievously excoriated her, added much to her sufferings, which with want of rest and appetite had wasted her to skin and bone. I told her that in order effectually to relieve her, and remove the cause of the swelling, I must lay open a great part of her belly, but feared she would not be able to undergo such an operation: she seemed not at all frightened but heard me without disorder, and though scarce able to speak, urg'd me to perform it. I must confess I drew almost all my confidence from her unexpected resolution, and without loss of time prepared what the place would allow, and with an imposthume lancet laid open about an inch; but finding nothing issue I enlarged it two inches, and even then nothing came forth but a little thin yellowish serum; so I ventured to lay it open about two inches more: I was not a little startled to find only a glutinous substance stop up so large an aperture; but my greatest difficulty was to remove it; I try'd my probe, I endeavoured to do it with my fingers, but all in vain; it was so slippery that it eluded every touch and the strongest hold I could take. I wanted, in this place, almost every thing necessary, but bethought myself of a very odd instrument, yet as good as the best, because it answered the end. I took a strong fir splinter, and having wrapt some lint about the end of it, I thrust it into the wound, and by turning and winding it drew out above two yards length of a substance thicker than any gelly, or rather like glue that's fresh made and hung out to dry; the breadth of it was above ten inches; this was followed by nine full quarts of such matter as I have met with in steatomatous and atheromatous tumours,

tumours, with several hydatides of various sizes containing a yellowish serum, the least of them bigger than an orange, with several large pieces of membranes which seemed to be parts of the distended ovary. Having squeezed out all I could, I stitched up the wound in three places almost equi-distant; and having no other but Lucatellus's balsam, with it I covered a pledget the whole length of the wound, and over that laid several compresses dipped in warm French brandy; and because I judged that the parts might have lost their spring by so vast and so long a distention, I dipt in the same brandy a large napkin four times folded and applied it over all the dressings, and with a couple of strong towels, which were also dipt, I swathed her round the body, and then gave her about four ounces of this mixture. $\mathfrak{R}$ Aq. menthæ $\mathfrak{H}$ ss. aq. cinnamomi fort. $\mathfrak{H}$ iss. syr. diacodii $\mathfrak{z}$ vi. m. ordering her also to take two or three spoonfuls of it four times a day. The cinnamon-water was drawn off from canary and the best cinnamon. Next morning I found her in a breathing sweat, and she informed me with great joy that she had not slept so much nor found herself so well refreshed at any time for three months past. I carefully dressed her wound in the same manner as above once a day for about a week; I kept in the lower part of the wound a small tent, which discharged some serosities at every dressing for four or five days. But business calling me elsewhere I instructed her daughters how to dress the wound, and told them what diet I thought most proper, which was chiefly strong broth made of an old cock, in each porringer whereof was one spoonful of cinnamon-water; this she repeated four times a day and it gave her new life and spirits. After three weeks absence I called at her house, and finding it shut up was a little surprized; but had not gone far before I was much more so, for I found her sitting wrapt up in blankets, and giving directions to some labourers who were cutting down her corn. She mended apace, and lived in perfect health from that time till October 1714. when she died after ten days sickness.

That this tumour, or rather dropsy of the ovarium, proceeded from the midwife's rashness in pulling away the placenta, seems plain from the woman's account of her delivery and the consequences of it. The placenta adhering fast to the uterus, required more art to bring it away than the midwife was mistress of, which induced her to use violence; whereby she forced down the fundus uteri and overstrained the ligaments and all that's appended to them, especially the ligamentum latum of the left side and its ovarium. Hence not only the elasticity of the lased parts was impaired, but the small lymphatics ruptured, so that the extravasated lymph rushing out thickened, and not being able to recirculate dilated the injured ovarium, till the parts being excessively distended, and no longer able to resist the new influx of fresh secretions, ruptured also, and by degrees increased to a huge and enormous bulk.

*Two uncommon
cases of tu-
mours of the
abdomen. By
Dr. W. Rutty.
n. 405. p. 562.
Nov. 1728.*

VIII. **T**HE two following Cases are extracted from a treatise published at Strasburgh in 1728, and intituled J. Boecleri M. D. ad exteros medicos epistola. The first is of a woman of Strasburgh, of thirty-two years of age, whose belly after an immature and hasty labour grew gradually for ten years. During the whole time of gestation she complained of scarcely any other symptom than the weight and heaviness of her belly, and now and then of a tense pain and difficulty in respiration. Flatulencies were sometimes discharged from the pudenda, and gave her great ease. The menstrua were regular as to time; but as to quantity she did not explain herself. In the latter months, towards her death, she grew plainly cachectic: her countenance was cadaverous; her breast and upper limbs perfectly emaciated; her feet œdematous, and the belly much more turgid and prominent than before; so that at length she breathed with the utmost difficulty, and upon taking any nourishment complained of a great straitness in her chest. Upon opening the abdomen two days after her death some water flowed out of a wheyish colour; the quantity was not taken notice of, but upon dividing the uterus, there was a plentiful discharge of a bloody liquor, together with seventy-two molæ of different figures and solidity, and chiefly of a black colour. One only was fixed to the lower part of the right side of the uterus, contiguous to its internal orifice. These solid substances weighed 64 ounces, and the liquor filled fifteen antient Alsace measures; so that the whole weighed 80 pounds apothecaries weight. The skin of the abdomen was very thin and almost transparent; the navel perfectly obliterated; the fat almost entirely consumed; the muscles pale, flaccid, and very thin; and the peritonæum in some places so strongly attached to the uterus, that it could not without the utmost difficulty be torn from it. The body of the uterus, which is naturally thick, was as thin and transparent as the cutis of the abdomen, and of a surprising capacity. The liver appeared pale and so flaccid that it might be easily rubbed to pieces. The height of the belly from the vertebræ of the loins to the navel measured $1\frac{1}{4}$ foot; its length from the cartilago ensiformis to the pudenda $2\frac{1}{2}$ feet; and its circumference at the waist 4 feet $2\frac{1}{2}$ inches, tho' the woman was naturally of a small size and stature.

The second is of a maid-servant in the same city, of twenty-three years of age, whose belly, from a suppression of the menstrua, grew slowly for three years without any other notable disorder; till upon an accidental fall it increased so much in six days as to obliterate the navel; and not being capable of a farther distension, part of the matter which caused the tumefaction flowed down to the legs, and swelled them likewise; which brought on a difficulty of breathing, a small, frequent and uneasy pulse, with a total loss of appetite. But what was more remarkable, the systole and diastole of the heart were plainly felt under the left clavicle, and the heart was upon dissection

found thrust up to that part of the thorax. The 14th day from the fall a diarrhoea came on which killed her in a few days. Upon making a small incision in the right hypochondrium there gushed out from the cavity a liquor in colour, consistence and froth resembling well boiled beer; which upon enlarging the incision was followed by a foetid purulent matter, with pieces of the putrified caul; the matter filled 56 Strasburgh pints. Upon this the belly subsided; but a large solid substance still remained under the containing parts of the abdomen. Opening therefore the whole cavity there was found under the left groin a considerable tumour, nourished by its proper vessels and every where fixed to the circumjacent membranes; from which being freed it weighed six pounds common weight. This tumour proved a congeries of incystated abscesses (wrapt up in one common covering) of different sizes; the largest as big as a man's two fists, the smallest the size of an egg; and each of a different sort of substance: besides which there was a great number of hydatides. The peritonæum was as thick as the cutis; the caul almost entirely destroyed; the stomach natural, but perfectly empty; the guts livid, very much thickened and vastly inflated, and moreover connected præternaturally to each other by peculiar membranes. The liver strongly adhered to the right hypochondrium, and its coat parted from its parenchyma almost spontaneously. The left kidney very near equalled the spleen in bulk, and the pancreas was as hard as a cartilage; but the uterus and bladder were found in statu sano. The cavity of the thorax was much smaller than usual, from the contents of the abdomen pressing up the diaphragm into it; and in it was found the same sort of bloody putrid liquor, as likewise in the pericardium. The right ventricle of the heart was præternaturally soft and flaccid, and being opened was lined with hydatides. The upper parts of the body were emaciated; the lower much tumefied by the water contained within them.

IX. **R**hedarius baronis de Penterrider, ætatis 58 annorum, temperamenti cholero-phlegmatici, staturæ quadratæ, non obesus sed robustus, bene appetens, officio suo bene fungens, nec vino nec liquoribus spirituosus immoderatè utens, bono satis regimine vivens, Augusti mense 1721. auxilium meum petit, pro abdomine fortiter tumente & tenso, ascitico minime absimili, urinâ tamen bonæ notæ & in quantitate sufficiente optimè prodeunte, pedum nullo cedemate comparente, respiratione liberrima, ventre autem in dies crescente (qui mense Junio tumere inceperat) sanguine in vasis hæmorrhoidalibus stagnante, nodos ibidem magnos elevante & interdum dolorificè furente, appetitum ac viribus nunquam prostratis. Fator ænigma mihi fuisse tamor esset siccus humidusne? ad satisfaciendum verò indicationibus, in specie hæmorrhoidibus suppressis, medicamenta chalybeata cum purgantibus mixta exhibui, per quæ fluxus hæmorrhoidum mox excitatus, dolores sedati, & magna sordium quantitas

A prodigious number of hydatides found in the abdomen. By Barth. Anhorn, Communicated by Dr. J. Thorpe. n. 370. p. 17. Jan. 1722.

titas cum aliquali levamine per tubulum intestinale fuit eliminata. Postea ad exemplum Etmulleri in hydrope sicco, nitr. præparat. quotidie ad unc. ss. item mercurium vitæ & omnis generis diuretica mitiora, fortiora, &c. omnia incassum dedi. Post hæc sanitatis recuperandæ spe, pro more vulgi, auxilium empiricorum imploravit, qui statim aureos illi montes promiserunt, multisque saginatum arcanis miserum in malis deseruerunt.

Abdomine igitur mole suâ maximè urgente, ad paracentesin sine morâ progrediendum erat; quam die 14 Jan. unanimi nostro consensu administravit chirurgus; contenta verò consistentiam gelatinosam nacta per angustius cannulæ immissæ spatium exire non poterant. Incisio ergo cum lancetta facienda erat; quâ factâ materia gelatinosa coloris grisei & lutei, albumine ovorum spissior, ad mensuras sex primo die evacuata est, una cum magna quantitate globulorum alborum sphericorum, triangularium, vermicularium, gemellorum testiculi- & ovarii-formium, &c. magnitudinem nucis avellanæ adæquantium ægro quantum ad vires optimè se habente. Postero die, cum facile judicare licebat incisionem non satis amplam esse ut exitum majoribus hujus naturæ globulis daret, lancettâ vulnus ampliatur, per quod globuli ovum columbinum magnitudine superantes magno numero, cum sex iterum gelatinæ mensuris, & magno frusto massæ cujusdam albæ portionem omenti referentis, de novo excreti sunt. Cui massæ plures dictorum globulorum filamentis fibrosis adhærebant.

In examinatione materialium, gelatina super carbonum ignem indurescit & albescit, pelliculam super se formans. Spiritu vitrioli, spir. sal. ammon. vol. ol. tart. per deliqu. spir. vin. rectific. aceto affusus, manifesti nihil aliud videtur, quàm levis induratio materiæ ab unoquoque istorum liquorum, etsi naturâ inter se invicem contrariorum. Globuli sunt albissimi, tactûi resistentes; rupti liquorem album chylo similem fundunt, membranâ seu pelliculâ manifestâ cincti. Massa ista albicans quæ portionem omenti refert, etsi crassitie pollicem adæquet, substantiam purè membranaceam habet. Numerus globulorum majorum & minorum ad septem vel octo millia se extendit.

Hodie, qui est exclusivè decimus sextus ab operatione dies, æger quàm optimè se habet, venter est mollis, planus, vulnus pulcherrimum, urina, pulsus, respiratio bona, consequenter nulla febris, somnus tranquillus. Evacuatio materiæ gelatinosæ durantibus 13 diebus fuit copiosa, inodora, nunc purè serosa & parca, sed fortem odorem spirans, immixtumque catheterem argenteum nigricans; quod corporibus heterogeneis corruptis magis quàm visceribus gangrænâ prehenfis attribuimus, quoniam febris abest. Hodie post injectionem decocti ex enula campan. agrimon. & mell. cum tinctur. aloes. myrrh. & balsam. du commandeur, pellicula globuli rupti excreta est, quem in statu suo naturali ovum gallinaceum mole adæquasse, fortassis superasse, certum est.

X. Peperit

X. **P**Eperit nuperrime domina quædam puellulam rite & eleganter satis conformatam, nisi quod in regione lumborum infima emineret tumor sive facculus, magnitudinis quasi pugni puerilis; pedes insuper ad nates usque retracti posituram sartoris incoxantis exhibebant; nec eos movere ullo modo, aut extendere poterat. Ego protinus vocatus & tumorem perlustrans eum ejusdem esse generis cum illis quos Tulpius cap. xxix & xxx. lib. III. observat. descripsit suspicabar: istum ideo fomento aromatico & adstringente foveri jussi. Intra triduum ita sero distentus evasit ut, extima ejus membrana jam disrupta, metus esset ne rupto confestim tumore, serum simul cum ipsa vita efflueret. Punctiunculam ergo suasi ut lymphæ sensim emitteretur, edito nihilominus prognostico, sive aperiretur tumor sive non, eum fore lethalem. Infans interea insomnis & ejulans parum dormiebat, ad pulticulam vero satis apta. Quarto adeo die tumorem aperuit chirurgus, facto largiore paululum quam consuluissim orificio, ita ut omnis intra horas viginti effluerit humor. Hinc languor summus & frequens deliquium ad biduum saltem; at nutrice sana & julap. cardiaco, cephalic. refecta vicessim ad usque diem vitam perduxit, quo frigidi sudores & tremores aborti tremulam hanc lucem extinxere.

A child born with a remarkable tumor on its loins, and the legs in an odd posture. By Dr. J. Huxham to Dr. Rutty. n. 413. p. 258. March 1730.

Inciso corpore observavimus dorsalem medullam ad ultimam lumborum vertebra, nec ultra, pertigisse; sed hanc inter & os sacrum (si mavis primum os sacrum) exiens per tumoris sive facculi membranas dispartita erat. Os sacrum porro erat solidum penitus, nec propagines nervosas medullæ spinalis (quibus apud anatomicos cauda equina vocabulum est) ad crura pedesque trans mittebat; quinimo ne quidem perforatum erat.

In quibusdam saltem a Tulpianis historiis supra citatis differt hæc nostra: neque enim aliquid matri prægnanti negatum, neque se ictu aut foetum imaginatione læserat unquam, neque spina hujus infantis bifida aut lacera: quinetiam nec os sacrum solidum, nec pedes contractos & immotos meminit Tulpius.

XI. **I**N villâ com' Surriæ, Ockley vulgò dictâ, anno 1711 nata est infantula, cujus in tergo circa vertebra inferiores apparuit tumor indolens, cutis colorem ovique columbini majusculi magnitudinem referens, qui cum puellâ tantoperè concrevit ut circiter nonum vel decimum ætatis annum vesicam vitulinam aëre distentam, sed sine cervice, planè repræsentaret. Anno 1728. vesicæ bubulinæ magnitudinem æquabat. Die 29 Jan. ejusdem anni in lecto jacenti disruptus est hic tumor, a quo multum liquoris instar urinæ profluxit. Re perspectâ invenimus tunicas, & interiùs materiam mucosam, ureteres, venas, & arterias tales omninò quales vesica habere consuevit: nec defuit commercium quoddam cum partibus internis per foramen in vertebra digitum hominis minorem in abdomen admittens, quod vasa memorata recipiebat. Die 2^{do} Feb. 1728, horam circiter decimam nocturnam obiit puella; & si cadaver aperire per parentes licuisset, credo eundem in abdomine vesicæ cervicem & nullam aliam vesicam invenissemus; non enim post ruptum tumorem vel semel minxerat.

A remarkable conformation of the urinary parts. By Mr. J. Budgen to Sir H. Sloane Bar. n. 410. p. 138. July 1729.

A hernia aquosa. By Mr. J. Ranby, n. 401. p. 414. Jan. &c. 1728.

XII. **A** Man aged 25 died of a pocky hectic, having some days before complained of a painful swelling in the testicle, which he said came the night before; I examined it, and finding it to be a hernia aquosa would have punctured it if I had not felt (besides the water) a hard body which I could by no means reduce. In a few days he died, which gave me an opportunity of being satisfied. Opening the scrotum and separating the common membranes to the processus vaginalis, I found it contained about four ounces of water, besides a great part of the omentum; some portion of which adhered to the bottom of the cavity and the albuginea that immediately covers the testicle.

A strange flux of blood thro' the penis. By Dr. Howman to Sir H. Sloane Bar. n. 379. p. 418. Sep. &c. 1713.

XIII. **Q**UADRAGENARIUS quidam civis Norvicensis pancratice valens profluvio sanguinis sinceri per canalem urethræ correptus est 30 die Junii 1716. Idem rediit phænomenon 31 Julii. Adhibitis quibusdam medicamentis & vena secta in brachio cohibitus est fluxus sanguinis prædictus, usque ad octavum diem Septembris, ac deinceps penitus evanuit. Notatu tamen est dignum has hæmorrhagias absque omni prævio dolore, seu postea spirituum dejectione contigisse.

Insects voided by the urinary passage. By Dr. Dan. Turner. n. 391. p. 410. Nov. &c. 1725.

XIV. **N**OV. 24, 1725. a poor woman came to crave my advice for an infant of about 16 months old, bringing with her a worm which she told me the apothecary had just then drawn out of its penis. The child had been very uneasy for several days before, continually drawing up its lower limbs and straining at both sphincters; the urine seemed to pass with difficulty for some time; at last there came on a total suppression, and the worm advancing shew'd itself at the extremity of the urethra. I examined the insect and found it measured above four inches, resembling the worms usually excerned per podicem, of the earth-worm kind but whiter; which made me think they were mistaken, and that it had come the other way. I went therefore to the apothecary, who has the worm now in his custody, to be better informed. He assured me, that when he came to the child he saw a præternatural body hanging half an inch out of the glans, and lying double in the passage: at first he knew not what to make of it; but perceiving it to advance he took hold of it, and with little difficulty drew it out.

The summer before last a woman shewed me an insect of the maggot species, with a crusty red galea over the snout, and a crescent or forked tail, which she had just then voided by the urinary passage.

Of the excretory duct of the glandula renalis. By Sig. Valsalva. Extracted from the giornale di letterati of Venice. 1719. n. 385. p. 190. Oct. &c. 1724.

XV. 1. **T**HE celebrated anatomist, Signor. Ant. Mar. Valsalva, already known by his noble treatise de aure humana, has lately made a considerable discovery. He has found the excretory ducts of the glandulæ renales, or renes succenturiati, which discharge themselves into the parts of generation; that is to say, into the epididymides in men, and into the ovaria in women. He has read a learned dissertation relating to this discovery before the academy of sciences in Bologna, in which he undertakes to prove that those renes succenturiati are to be reckoned among the principal organs of generation.

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XV. 2. **I** lately procured a human body in order to search for the above-mentioned duct, which I did with all the diligence I was capable of. I was not so happy as to discover it; but having injected the aorta I found the arteries going to the glandulae renales disposed as in fig. 84. Now whether that branch of the artery, which from the glandulae renales goes down on both sides towards the testicles without supplying any of the neighbouring parts, might not have been mistaken by the above-mentioned learned anatomist for an excretory duct, all arteries being generally in dead bodies free from blood and of a whitish colour, I will not presume at present to determine for want of farther experiments.

Fig. 84. A A. The right kidney.

B B. The left kidney.

C C. The descending trunk of the aorta.

D. The right emulgent artery.

E. The left emulgent artery.

F. The right glandula renalis.

G G. The right spermatic artery.

H. The left glandula renalis.

I I. The left spermatic artery.

K K. The ureters.

a a. A small artery arising out of the descending trunk of the aorta, a little above the right emulgent artery. It sends two branches b b upwards to supply the right glandula renalis. A third branch c c goes downwards towards the right spermatic artery G G, and proceeds in company with it to the right testicle.

d d. A small artery arising out of the left emulgent artery, near the descending trunk of the aorta, and going directly upwards to the left glandula renalis H.

e e. A small artery arising out of the descending trunk of the aorta, a little below the left emulgent artery. It divides into two branches, one whereof ff goes upwards between the emulgent artery and vein to the left glandula renalis, the other g g downwards towards the left spermatic artery, and in company with it to the left testicle.

XV. 3. **I** Have since found the same arteries in women, descending in the same common capsula with the spermatic artery and vein to the ovaria. These arteries very probably are what the late excellent anatomist, S. Valsalva, took for excretory ducts of the glandulae renales, the disposition and progress of these being very much alike to what has been ascribed to those supposed ducts.

XVI. **E**ustachius is the only author I have met with, who has given us any delineation of an immediate communication between the spermatic arteries and veins, during their course along the cavity of the abdomen. Boerhaave from him makes mention of the anastomoses in his institutions; and also cites Leal's treatise

Of the same.
By Mr. J. Ranby. n. 387. p. 270. March 1725. Fig. 84.

Of the same.
By the same. n. 395. p. 159. Aug. 1726.

Uncommon anastomoses of the spermatic vessels in a woman. By Dr. C. Mortimer.

Περὶ Σπερματιζόντων ὀργάνων, where he fully refutes de Graaf, who denies them: but even Leal owns he never saw them, and only argues for them from the effect and the close union of the spermatic vein and artery in one covering. Marchetti in his anatomy asserts these anastomoses, but neither do I find that he ever saw them; nor have I hitherto conversed with any, even the most celebrated for their injections, who had hit on a subject where these passages were open enough to transmit the matter they inject with.

Fig. 85.

In 1723, being at Paris, I met with a female subject where these anastomoses were as large as the spermatic vessels themselves; and the arteries being first injected with a mixture of wax and tallow, tinged with vermilion, and the veins with the same tinged with smalt, the injection ran out of the artery into the vein, and on the other hand out of the vein into the artery, so that where one vessel entered the other the injection was tinged purple. What appeared most remarkable in this subject was, that on the right side were two spermatic arteries A and B. One, A, arose from the very angle made by the emulgent and the trunk of the aorta descendens C, which contrary to the common course ran under the vena cava, and soon after it was got beyond it sent out a lateral branch, or anastomosis, descending obliquely EF into the spermatic vein G, through which the red matter penetrated into the vein; which being afterwards filled with blue became purple all about the orifice of this vessel at F, which seems to confirm Eustachius's delineations. The other right spermatic artery B arose as usual out of the trunk of the aorta; but about half an inch from its rise it sent out an anastomosis IK, ascending obliquely into the body of the vena cava D, through which a large quantity of the red matter passed, so as to tinge a very broad place at K in the vena cava purple. About an inch below this orifice was another anastomosis LM, through which the blue matter penetrated out of the vein and made the contents of the artery purple at L. The right spermatic vein had only this one anastomosis ML, in all other respects as usual. On the left side was but one spermatic vein O, and one spermatic artery N, which took its rise out of the body of the aorta near the angle made by it and the left emulgent artery, then ascending between the emulgent vein and artery turned in an arch at Q over the left emulgent vein, and so joined the left spermatic vein as usual, which rose out of the left emulgent vein. There was on this side one thing very uncommon, which was a short anastomosis RS (about a quarter of an inch in length) from the left emulgent artery S, which making an arch under the left emulgent vein was inserted into the anterior part of it at R.

AB. Two spermatic arteries on the right side.

CCC. The aorta descending.

DDD. The vena cava ascending.

EF, LM. Anastomoses of the spermatic veins and arteries.

G G. The right spermatic vein.

H. The right ovary.

IK. An anastomosis of the spermatic artery and vena cava.

N Q N. The left spermatic artery.

O O. The left spermatic vein.

P. The left ovary.

RS. An anastomosis of the emulgent vein and artery.

TT. } Arteries and veins dispersed on the fat and membranes

V V V. } enclosing the kidneys.

XVII. 1. **A. B.** de parochia Lanteglafs in comit. Cornubiæ, *A præternatural structure of the parts of generation in a woman. By Dr. J. Huxham to Dr. Jurin. n. 379. p. 408. Sept. Ec. 1723.*
cuidam robusto nupsit, tandemque prægnans & partium male conformatarum sibi conscia opem imploravit chirurgicam. Accersitum voluit D. Bonnett de Fowye oppido, virum artis chirurgicæ & obstetriciæ peritissimum. Ille vero perspecto denudato corpore sequentia observavit.

Loco umbilici, paululum vero inferius, prominet massa quædam spongiosa, carnis quasi offam præ se ferens, abdomini transverse incumbens, magnitudinis fere ovi gallinacei, longa autem tres digitos: ex hac duo erumpunt meatus urinarii exiles qui urinam perpetim exstillant, quam neque vel retinere vel ejaculare potest mulier; hinc vesicam, si quæ adsit, sphinctere caruisse concludendum. Spongiosa hæc mollisque massa, urinæ acrimonia corrosa, tactum refugit mollissimum; qua de causa eam linteis involvit tenuissimis, & incurvata incedit ad dolorem a vestibis evitandum. Hanc massam funem fuisse umbilicalem male a partu abscissum, male dein curatum, existimo; ne vel minima enim umbilici, nisi hic, apparent vestigia; quid quod & urina per urachum pervium, & in duos forsan tubulos divisum, vel saltem per canales duos proprios effluit. Priori potius credo opinioni; quia dantur historiæ urinam per umbilicum in adultis etiam excretam fuisse attestantes^t. Hanc infra offam subintrat vaginæ foramen, ab offa distans brevissimo spatio: ex hoc effluebant catamenia, per hoc etiam gravida facta est mulier; haud magnam vero in coitu percepit voluptatem & summa penis glans vix fuit intromissa, ægrè enim digitum introduxit chirurgus ut uteri collum exploraret, quod tamen non percepit; plane autem deprehendit membranam crassam hocce orificium ab altero inferiore, jam describendo, separantem. Eo fere ipso loco, superius vero paululum, ubi in mulieribus rite conformatis adest fossa magna invenitur foramen alterum oblongum, ne vel minimi digiti apicem altius admittens, recto intestino, uti post partum observatum fuit, pervium; quod a sectione fortasse accidit: nullus autem hic occurrit sphincter: inferius vero rectum intestinum, more solito, cum sphinctere circumdato terminatur. Orificium hoc oblongum ab orificio vaginæ, abdomine

^t Vid. Hist. de l' Acad. Royale de Sciences, Anno 1701.

maxime tumente, duos saltem digitos transversos distabat, inter quæ membrana descripta intervenit ab interiore parte, hujusce vero fissuræ oblongæ quasi labiorum coalitio exterius e superiore foraminis parte. Nulla hic clitoris, nulla ossium pubis aderant vestigia, nisi, quasi apophyses breviores ex utriusque ossis illi parte inferiore protuberantes, ossium pubis rudimenta dixisses. Hic fuit ante partum rerum status.

Die 18 Julii 1722, hora noctis 11^a advocatus est D. Bonnett ut parturienti opem ferret; qui foetum invenit infra vaginæ orificium delapsum, eumque muliere decumbente superiora versus propellere frustra adnixus est, ob fortissimos foetus motus & gravissimos matris dolores, cui etiam jam supervenerant convulsiones, syncope, &c. Vaginæ autem orificium vix aut ne vix quidem dilatatum, ita ut illam jam jam morituram omnes expectarent. Misericordia & humanitate adductus chirurgus posthabuit omnino quid vel ignari vel invidi garrirent, ancepsque experiendum esse remedium potius quam nullum apud se statuit. Parentibus periculosissimum rerum statum enarravit; nil nisi a sectione expectandum, ejusque tamen ancipitem eventum. Annuentibus tandem matre & astantibus in orificium oblongum inferius scalpellum chirurgicum introduxit, & uno ictu coalitionem labiorum orificii & membranam separantem divisit: hinc in unum coivere & orificium vaginæ & oblongum inferius. Jam digitis facile intromissis orificium uteri internum attrectavit, dilatavit paululum, caput inde sensit infantis, foetusque ori intruso digito puellulam vivam, probe formatam, extraxit, quæ adhuc viget & valet: uti & ipsa mater, quanquam post puerperium cum febre graviter colluctata. Jam a partu uteri prolapsu divexatur, quo prolabente nec per horas 8, 10^{ve} reducto, eam dein si fortius intrudas exiliunt e meatibus urinariis descriptis rivuli duo ad pedis saltem distantiam; argumentum sane cystidis cujusdam urinam excipientis: aliter revera suspicatus fuisset meatus istos duos urinarios ipsorum ureterum fuisse orificia hic terminantia.

Quærat fortasse curiosior aliquis, quo forte modo gravida facta sit muliercula nostra. Illi responderem penis intrusionem ad prolem concipiendam haud absolute esse necessariam, feminis autem intra vaginam ejaculationem quam maxime^u.

Fig. 86.

Fig. 86. A A. Spongiosam assimulat quasi carnis massam, quam partem fuisse chordæ umbilicalis autumo, magnitudinis fere ovi gallinacei, tres vero digitos longam. Ex hac duo erumpunt fistulæ urinariæ b b, quæ urinam perpetim exstillant, nec ex ullo alio orificio redditur urina.

c. Orificium vaginæ, cloacæ galli gallinacei quam simillimum, spisso quasi septo circumdatum: per hoc effluebant *impulsa*, per hoc etiam gravida facta fuit mulier. Hoc orificium, dum patiebatur

^u Vid. Hist. de l' Acad. Royale des Sciences. 1712. Vid. etiam Mauriceau.

mulier gravissimos partus dolores, nullo fere modo dilatatum fuit, quanquam anus ipse ob vehementissimos musculorum abdominis, &c. contractiones maxime hiaret.

d. Locum indicat ubi inventum fuit foramen oblongum minimi digiti apicem vix admittens. In hoc chirurgus introduxit scalpellum & ab hoc in orificium superius adegit : ita ut jam a partu dehiscat ingens foramen.

Orificium superius transversum ab inferiore oblongo (appropinquante partu) 2 fere digitos distabat. Ex hoc magno hiato ipse uteri prolapsus sæpissime nunc patitur. Ex loco etiam ubi aderat olim orificium inferius jam a puerperio partim excretæ sunt fæces alvinæ : hoc vero ante partum minimè observatum fuit ; ita ut a sectione forte acciderit.

e. Anum repræsentat paulo magis antrorsum quam in aliis positum : per hunc maxima fæcum pars egeritur. Pudendum hoc est non dense crinitum.

XVII. 2. **S**ubstantia quædam carnosæ, spongiosa, floride rubescens, levissimum tactum ob atrocissimum dolorem inde oriundum fugiens umbilici naturalem locum usurpabat, & e cavitate quæ plerumque ibi est quasi pullulabat. Ex hac excrefcentia, quæ nec augeri nec minui per multos annos sentiebatur, continuo destillabat urina, quæ nec alia exire via, neque hæc poterat vel violentissimis nixibus cum impetu expelli vel per saltum excerni, adeo ut paulatim exsudans vestes interdiu, substragulaque noctu madefaceret. Paulo infra, ad distantiam pene palmi minoris, orificium quoddam, longitudine unciam unam, latitudine digitum transversum æquans, sese ostendebat, satis amplum ut indicem admitteret, & tamen perstringeret. Hac via effluebant a pubertate menstrua, unde ad vaginam & uterum hunc esse aditum facile patet. Ad eandem fere distantiam qua orificium hoc vaginæ ab excrefcentia illa distabat patebat & orificium alterum, superiore minus, digitum minimum vix capiens. Huic autem orificio cum intestino recto communicationem dari tenuissimæ fæcum partes ex eo frequenter protrusæ satis demonstrabant ; anus verus, per quem excrementa duriora dejiciebantur, uncis quinque vel sex ab hoc orificio distabat naturalem fere pudendorum situm obtinens : pili quidem aderant, sed rari, nec margines unius alicujus orificii magis quam reliquorum ornantes, sed duas lineas describentes, quæ a medio spatio inter excrefcentiam illam & commissuras femorum cum abdomine incipiebant, & sibi mutuo appropinquantes angulum in cujus vertice positus est verus anus conficiebant. Hunc in modum conformata valetudine satis bona fruebatur virgo ; sed illam æterna virginitate necessario laboraturam concluderant omnes quibus res innotuerat. Advenit tandem nauta quidam qui illam duxit, & non multo post imprægnavit. Gestationis tempore optime se habuit mulier ; quo propemodum finito de difficultate pariendi, non sine ratione, aderat gravis suspicio. Orificium

*Of the same.
By Dr. W.
Oliver to Dr.
Mead. ibid.
p. 413.
Fig. 87.*

vaginæ

vaginæ a viri congressu non omnino dilatatum erat, adeo ut de modo imprægnationis multæ inter mulierculas ortæ sint disputationes. Immissionem autem penis in vaginam ad imprægnationem non esse absolute necessariam non est quod narrem; exemplis turgent libri medici. Mulier tamen de vita sollicita a chirurgis consilium petiit. Unus tandem apud Fowye oppidum, ad promovendum partum, si opus esset, operam suam promisit. Gestationis tempore perfecte finito, dolores aliaque symptomata partum prognosticantia illam tentaverunt. Chirurgus advocatus aderat. Refert ille infantem conatus suos fecisse ad regionem pubis, illa ipsa autem ad orificium vaginæ. Dixit ille incisione exitum infanti esse aperiendum; ex crudeli misericordia renuunt adstantes, ingravescent dolores, superveniunt convulsiones, vita desperatur. Tandem cum mortem præ foribus esse omnes judicarent illam pene expirantem in manus chirurgi tradiderunt. Ille statim dissectionem isthmi qui inter orificium vaginæ & pseudo-anum erat, & haud improprie perinæum possit vocari, instituit. Integumentis exterioribus dissectis membrana quædam valida & crassa transverse locata, sese in conspectum dedit, quæ vaginam a canaliculo illo inferiore dividebat. Hac dissecta iter ad uterum satis amplum patuit, manum introduxit, os uteri digitis dilatavit, infantem capite prehenso, in lucem tuto eduxit, matrem ad vitam revocavit. Hanc mihi ipse historiam retulit, illa confirmavit. Rei enim novitate percussus Fowye adivi, veritatis cognoscendæ gratiâ. Chirurgum de structura partium originali, & operatione sua sollicitè interrogavi. Omnia ut supra narraui graphice descripsit. A muliere etiam ut partes viderem obtinui; illaque ad examen commode locata excrecentiam umbilici cavitatem usurpantem superiori descriptioni ad amissim respondentem inveni. Illam cum summo digiti levissime tetigissem misella non aliter ac si gladio perfoßa fuisset ejulavit. Mirum sane mihi videtur hanc mulierem cum marito suo potuisse congredi; ex situ enim partium necesse est ut vir rei venereæ incumbens excrecentiam illam, aliter prorsus intactilem, abdomine suo duriter perfriceret. Rogata quomodo hæc perficiebantur respondit se omnia ob amorem quo maritum suum prosequeretur posse pati.

Hæc excrecentia ex multis lobulis, propriis membranis obductis, a se mutuo distinctis, conflare videtur. In interstitiis horum lobulorum poruli per quos stillabat urina oscula sua ad superficiem aperiebant. Paulo infra hiatus magnus, ex unione chirurgica duorum orificiorum ad partum facilitandum confectus, sese ostendebat. Procidencia uteri tunc temporis laborabat, qui extra labia propendens longitudinem sex unciarum, magnitudinem ovi anserini æquabat. Tali procidencia se semper a partu usque laborasse narravit, & quidem mirum esset si aliter accidisset; tanta est enim ad orificium vaginæ apertura ut nihil possit ab extra uteri prolapsui obstare, & uteri corpus multo magis quam in statu vulgari a vesica premitur. Verisimile enim est urinam ad excrecentiam illam per urachum ascendere

& per illum ab initio fluxisse, quia per meatum urinarium nullum natura præbuit exitum; impossibile tamen est ut urina per urachum ad umbilicum ascendat, priusquam vesica sit turgidè repleta; ex illa vero plenitudine necesse est ut semper uterus non parvo pondere premat & illum foras extrudat. Ut conformatio partium melius appareret, reclinata in lectum muliere, repositionem uteri tentavi. Non citius illum introducere cœpi, quam urina a pressione in vesicam repletam facta per poros excrescentiæ umbilicalis, multis rivulis pilum crassiolem magnitudine non superantibus, cum impetu ad plures pedes profiluit; exinanita vesica vaginam inversam in naturalem situm facile restitui; restitutis vagina & utero dehiscere chasma magnum ex positione corporis circulare, ejusque diametrum tres pollices transversos metiri credo, cujus fimbriæ, potius quam labia, multis sarcomatis inæqualiter horrebant. In superiore ejus margine interno meatum urinarium frustra quæsi, in inferiore pseudo-anum facile inveni, per quem digitum sub pubem, quæ ad cartilagineam mollietiam accedere videbatur, ad intestinum rectum immisi, unde credo rectum ad tres pollices supra sphincterem ani esse perforatum. Paulo subtus pubem, situm quo aliarum sinus ipse pudoris gaudet verus anus hujus fœminæ obtinet.

Fig. 87. a. Excrescentia umbilicalis.

b. Orificium vaginæ.

c. Pseudo-anus.

d. Anus.

e e. Pili.

Fig. 88. a. Excrescentia umbilicalis.

b. Os uteri.

c. Anus.

XVII. 3. **A**S there appears to be some difference in the preceding accounts, I take the liberty to write you what I know of the matter. This I the rather do, as I repeatedly observed the wonderful structure of the parts before the birth approached, and before I was obliged to make the incision.

This woman was about 23 years old when she was married, and some time after conceived. As she was conscious of the præternatural structure of the parts, and her mother apprehensive of the danger that would attend the delivery under such unhappy circumstances, they applied to me about the seventh month in order to engage my assistance. On viewing the abdomen I made the following observations: there was no sign of the umbilicus; but about three inches lower than it is regularly placed in persons naturally formed, there was a spongy, fleshy extuberance, nearly of the shape and bigness of an hen-egg: not, as Mr. O—— says, composed of many lobules enveloped by distinct membranes, but entirely resembling that luxuriant or proud flesh which is thrown forth in ill-digested wounds. This was exceeding tender, and could not bear the least touch. On

Of the same.
By Mr. J. Bonnett to Claud. Amyand Esq;
n. 384. p. 142.
July 1724.

the lower part of this excrescence I perceived two small orifices, the one distant from the other about an inch. Thro' these the urine drops continually, nor is she able to retain it; but by violent efforts can make it spout out near a foot. Mr. O——'s account of its spouting out multis rivulis is certainly erroneous. The two orifices by which it is indeed discharged are now very evident, and will easily admit a small probe. About $\frac{1}{2}$ inch below this protuberance was a transverse orifice, much resembling the anus of a cock. Thro' this the menstrea regularly flowed, and by this she was impregnated. 'Twas with some difficulty I thrust my finger into this orifice in order to reach the os tincæ, which lay so deep that I could by no means feel it; but I plainly felt a thick transverse membrane separating this passage from an orifice which is situated about two inches below that already described. This lower orifice seemed to be placed exactly where the symphysis of the ossa pubis is in women regularly formed, somewhat above the place where the natural hiatus should have been. I could but just enter the tip of my finger into this. There were a few hairs scattered up and down irregularly about this orifice. The anus terminated as usual with a sphincter, about two inches below this lower orifice and much more forward than usual. So then the upper orifice, which may be properly called the orifice of the vagina, was about $\frac{3}{4}$ inch below the umbilical excrescence: the lower oblong orifice (or another passage to the womb) was about two inches below that of the vagina; contrary to Mr. O——'s account, who makes the superior orifice to be near four inches below the excrescence, and the lower orifice four inches from the superior; and then says the anus, which he rightly enough makes to usurp the place of the fossa magna in women naturally conformed, was five or six inches below this. According to this proportion, the woman must be really gigantic; whereas she is a short, little woman; nor do Mr. O——'s cuts any way represent the case. This woman had no os, or ossa pubis; indeed there was an apophysis jutting out from the lower part of each os ilium, but they were far from being join'd, as usual, by synchondrosis.

July 18, 1722. I was sent for late at night, and found the woman with true labour pains upon her. The throws were excessive violent and the continued agony had almost quite exhausted her spirits; but the orifice of the vagina was no way sensibly dilated, tho' the anus thro' the violence of the throws opened extremely wide. In vain were all endeavours to relieve her by thrusting up the child and putting the mother in a proper posture. Vain were her own throws and agonies. Convulsions now had seized her, and nature seemed to deny a longer life to the mother, or an entrance into it to the child. I was in the utmost perplexity what to do under these circumstances. On the one hand I considered that if there was not a passage made for the child and that by incision, both mother and child must speedily perish.

On

On the other I foresaw the danger and hazard of an incision, and the unavoidable censure of having killed the woman if she should die under the operation. At last humanity prevailed with me to try a doubtful method of preserving life rather than none. I told her mother and the other persons in the room, that death was inevitable without making the passages wider by incision and so attempting a delivery; withal apprizing them of the uncertainty of the event of the operation. When they saw her (as they thought) just expiring they delivered her into my hands to do with her what I thought fit. I immediately thrust my scalpel into the inferior oblong orifice, and directly cut into the orifice of the vagina; so brought them into one: then presently with my scissors I snipped the transverse membrane. This being done I easily introduced my hand, felt the head of the child, and with my finger thrust into its mouth drew forth a female infant, living and well formed, to my own surprize and the admiration of all. Ever since she was delivered she hath suffered a prolapsus uteri upon the least standing or walking. I proposed to remedy this by a suture, as is practised in the case of the vulva breaking into the anus; but she would by no means admit of it: so that she almost continually labours under a procidentia uteri; and the body of the womb and vagina are so corroded by the acrimony of the urine, that there are four or five ulcers formed upon them. Besides this inconvenience, some of the thinner parts of the excrement are discharged at the bottom of this large cleft, and by introducing my finger at the bottom of the cleft, I can easily thrust the top of it thro' the anus: which is an argument that there could not be five or six inches between the oblong orifice and the anus, as is asserted by Mr. O——, the distance being scarce above two inches.

Fig. 89. A. Epigastrium.

B. Regio umbilicalis.

C. Hypogastrium.

D. Regio pubis.

E E. Spongiosa ossa.

F F. Meatus urinarii, a partu satis visu faciles.

G. Orificium transversale.

H. Oblongum orificium.

II. Cicatrices duæ, ex urinæ, ut videtur, acrimonia.

K. Anus, paululum anteriùs locatus.

Fig. 90. Fissura magna quatuor pollices oblonga.

L. Procidentia uteri.

M. Os tinæ.

Fig. 89.

Fig. 90.

A monstrous double birth in Lorrain. By Mr. Fevry.

Communicated by Mr. Colin Mac-Laurin. n. 377. p. 346. May 1723.

XVIII. **S**ebastiana Camus, aged 44 years, living at Domp Remy la Pucelle, was delivered on Christmas eve 1722, about eight o'clock in the evening, of two children or twins joined together as appears by fig. 91, 92. viz. there is one head, one neck, one breast, one abdomen, and two hands on one side; and there are as many

parts on the other ; the whole being well proportioned and plump, joining together by the belly which is common to both, so that one of the heads is in the place where the other's feet should be, and the other's head is in its natural place ; they have but two legs for both of them, which seem to arise from the transverse apophyses of the vertebræ of the loins on one side ; and from the opposite region of the loins comes out a leg ending with a joint which bends forwards, and at the extremity forms a small stump, like a finger, articulated by ginglymus. There is but one fundament for both, by which they void their excrements ; they have but one navel-string, and the parts proper to the female sex are also single : they eat and drink with their mouths severally, and while the breast is given to one the other cries for it : they sleep and are awake, sometimes both at the same time, sometimes separately. Each of these children has been baptized ; one of them is somewhat plumper than the other, which is more puny and not so fresh-coloured. The head of the one, which is a little bigger than that of the other, came first to the birth, the two arms lying on the breast followed next ; the legs lay on the sides of the breast of the second ; the opposite leg, which is single, was extricated afterwards ; last of all the arms of the second child being ranged on the side of its head made it easy for the rest to come out. The bodies of both these children make no more in bulk than that of one ordinarily does. It is observable that the mother can assign nothing that had any relation to this event during the time of her pregnancy.

Fig. 91.

92.

93 & 94.

95.

96.

97.

Fig. 91. Represents the fore view of the twins.

92. Their back-part.

93 & 94. The skeleton.

95. The breasts and abdominal muscles, after the external teguments were removed.

96. Part of the viscera of the abdomen.

97. The urinary and genital parts.

These children lived two months.

The two first figures were drawn in their life-time, and the five following were taken after their death, by order of his royal highness the Duke of Lorrain.

*An account of
a foetus that
continued 46
years in the
mother's body.
Communicated
by Dr. Stei-
gertahl. n. 367.
p. 126. Jan.
Ga. 1721.*

XIX.1. **A**Nna Mullern of the village of Leinzelle near Gemund in Suabia, of a dry and lean constitution, but otherwise healthful and robust, died at the age of 94 after she had lived a widow forty years. Six and forty years before her death she declared herself to be with child and had all the usual tokens of pregnancy. At the end of her reckoning the waters came away and she was taken with the pains of labour, which continued upon her about seven weeks and then went off upon the use of some medicines given her by a surgeon. Some time after this she recovered her perfect health, except only that her belly continued swelled, and that now and then upon any exercise she felt a little pain in the lower part of it. After this she had

Fig. 69.



Fig. 70.

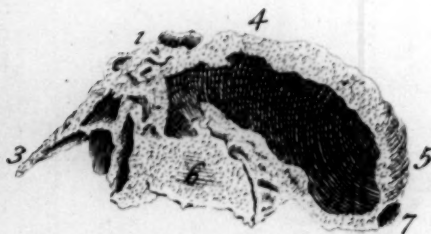


Fig. 71.

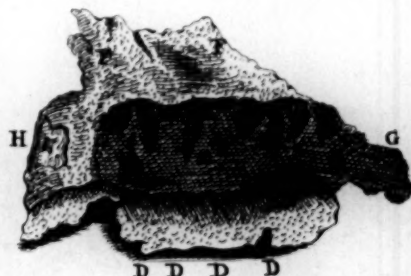


Fig. 75.



Fig. 77.
Y Z



Fig. 78.

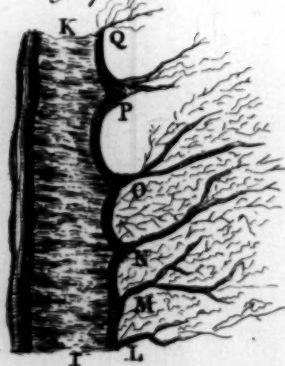


Fig. 79.



Fig. 80.

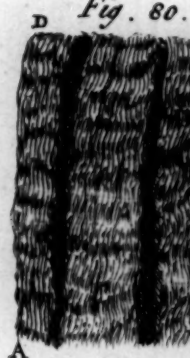


Fig. 84.

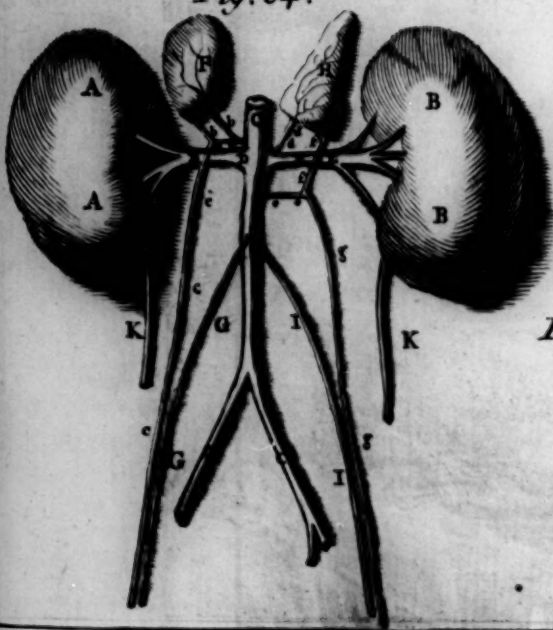


Fig. 85.

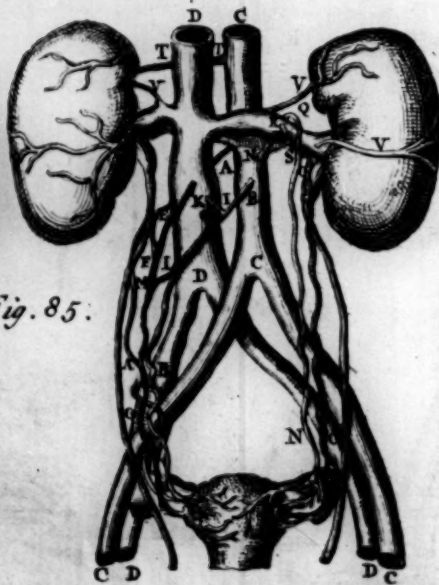


Fig. 86.



Fig. 72.

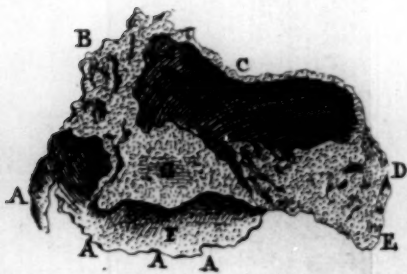


Fig. 73.



Fig. 74.



Fig. 82.



Fig. 83.

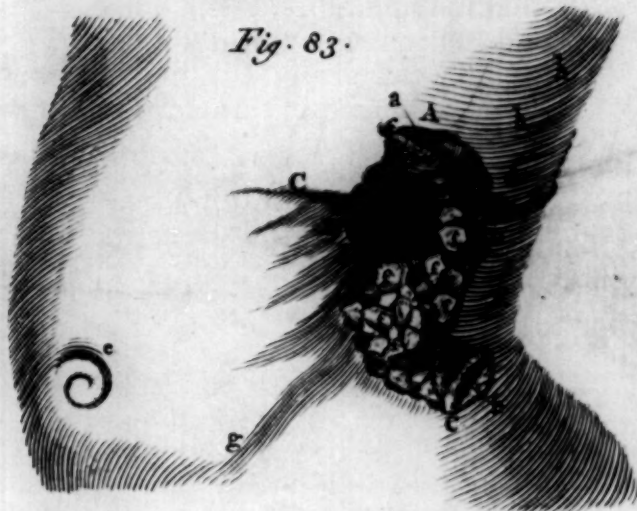


Fig. 81.

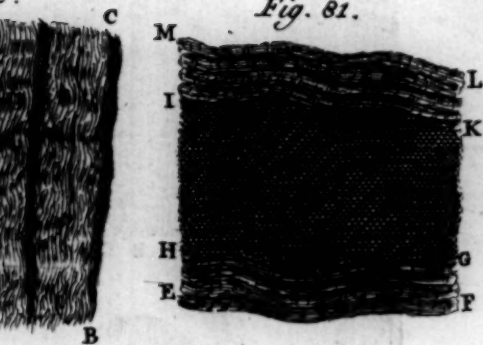


Fig. 89.



Fig. 90.



Fig. 87.



Fig. 88.



had two children, first a son, who is now a huntsman at Bischoffsheim, and afterwards a daughter, who is married to a soldier; but notwithstanding this she was firmly persuaded that she was not yet delivered of what she first went with. March 11, 1720, she died after four days illness, and her body was opened by a surgeon, who found within her a hard mass of the form and size of a large ninepin-bowl, but had not the precaution to observe whether it lay in the uterus or without it, and for want of better instruments broke it open with a blow of a hatchet. This ball with the contents of it, are expressed in the following figures, where

Fig. 98. represents a part of the tegument which had adhered to Fig. 98.

a spongy fleshy substance. This at first seemed to be a mass of cartilage, but was afterwards found to be entirely bony.

B. B. B. C. C. C. Shews the membranous part which was bloody.

D. D. D. D. The opening made by the hatchet.

E. E. E. E. E. Another part of the tegument appearing entirely bony with several prominences.

F. A contusion occasioned by the rude manner of opening it, where there appeared some putrified membranes.

Fig. 99. A. A. A. The tegument or substance enclosing the foetus. Fig. 99.

B. The foetus.

C. A depression or hollowness on the right cheek.

α. The nose turning up.

β. The mouth flatted.

γ. The eye closed up.

δ. The ear.

D. D. The arms, of which the right was the larger, and the two joints of that thumb were plainly to be seen.

E. The protuberance of the knee.

F. Part of the funiculus umbilicalis torn, but still adhering to the navel.

G. G. Part of the same fastened to the bony part of the tegument.

H. The breast.

I. The mark of an incision into the left side, where the flesh appeared red, but was dry and looked like smoked beef.

Fig. 100. Represents two ribs from the left side, of their natural Fig. 100.
substance, colour and bigness.

A. A. The part joining to the vertebræ.

B. B. to the sternum.

This piece is preserved in the D. of Wirtemberg's cabinet of rarities.

Dr. Camerarius professor at Tubingen in a letter upon this subject takes notice, that the surgeon found this mass in a cavity on the woman's left side, and that it adhered to the membranes of that cavity by the intervention of a spongy, fleshy substance. From which particular and the woman's having had two children during the time that this large mass lay in her, he conjectures that it was
not

not lodged in the womb, but in the left Fallopian tube, which by this means was very much dilated and thickened in its substance.

An extra-uterine foetus that had been five years and a half in the mother's body.
By Dr. Rob. Houstoun.
n. 378. p. 387.
July &c.
1723.

XIX. 2. I was sent for in August 1717. to a woman near New-
port Market who had been married 18 years to a native
of the E. Indies, by whom she had eight children, besides two mis-
carriages. She was now with child by a second husband, who was a
vigorous young man. Being near her full time and having felt pains
for several days by intervals, she concluded they would as usual bring
on her delivery. Her mother and midwife apprehending no difficulty
assured those about her that only time was wanting. But I found on
examination that her womb was of no bulk to contain a child near its
time; and that its neck, of an uncommon hardness, was also clos'd
so straitly as to refuse the admission even of a small probe or knit-
ting needle. I declared upon this that her delivery was impossible;
because the child was not within the womb, but between the womb
and the guts: that it might be removed by a passage to be made for
it, without any great pain and with safety to the mother. I offered
to undertake it, and assured them that this was the only opportu-
nity; and that if she neglected it, it would hereafter be out of the
power of art to give her relief, unless favoured by some unlikely and
extraordinary accident. However confidently I affirmed it, they re-
jected my assistance. At that time it would probably have been suc-
cessful; for she was a slender well-shaped woman, in good habit of
body, and of a sprightly disposition. About a year after this I was
again desired to visit her. I found her much disordered by a grow-
ing imposthumation in her belly, and ordered her some cordial sto-
machics, Cassia, and such gentle lenitives, which met a success be-
yond my expectation; so that by aid of a regular diet, and the
watchful care of a very tender mother, I restored her to such strength,
that she went chearfully abroad, and re-applied herself to business.
About fifteen months from the time when I visited her first, her
mother came from her to entreat my assistance. She complained of
great pain in the lower part of her abdomen; and I found a tumour
of a conic form projecting about an inch beneath the umbilicus: its
inflammation, attended with tension and a feverishness, so plainly in-
dicated suppurations, that I was not surprized to hear in a few days
that it had broke as I wished. I proposed to lay it open, both to
give a free emission and prevent its becoming fistulous; but she was
apprehensive that I would cut open her belly, as she expressed it; so
that not being able to prevail with her, I ordered a pot of unguent
and some plaisters. The ulcer soon grew fistulous and so continued
till she died. For above five months before her death she voided
her excrements by this vent, with all the soft parts of the foetus, and
some small bones of its fingers. But the rest of the skeleton remain-
ing entire, I took it out of her body, together with the vagina, ute-
rus, rectum, &c. wherein it had involved itself.

She was full nine months gone in August 1717, and died the 23d of March 1723, on which day I took it out.

Fig. 101.

Fig. 101. A. The clitoris.

BB. The nymphæ.

C. The rima, or entry into the vagina.

D. The bladder.

EE. The ureters cut off.

F. The uterus sound and entire.

G. The left ovarium.

HH. The tubes.

I. Part of the colon cut off.

K. Part of the peritonæum.

L. Part of the ileum cut off.

M. Part of the cæcum.

O. Part of the cranium that plainly appears.

P. The ulcer, through which the excrements passed, with some small bones.

QQQQ. The bulky mass, wherein the skeleton is contained, between the uterus, part of the vagina, and rectum.

RR. Part of the cutis.

Fig. 102. represents the same in a lateral view.

Fig. 102.

A. Orificium vaginæ.

B. Anus.

C. Intestinum rectum.

DDD. The mass, wherein the skeleton is contained.

E. The costæ plainly appearing.

F. The bladder laid aside.

G. The ureter cut off.

H. The uterus.

I. The ovary.

K. The tube.

L. Part of the colon.

M. The ulcer, through which the excrements passed, about one inch beneath the navel.

N. Bones in the orifice of the ulcer.

XXI. 1. **T**HE following relation is extracted from the Act. Liter. Suec. Trim. 1. 1723.

Mulier quædam ætatis 41. quatuor vero annos nupta, a. 1720, mense Julio, ingravida fructumque fert per septem menses, visis tamen interdum paucis menstruis, sed sperans justo demum tempore parentem se futuram. Præterlapso hoc tempore evanescente tumorem sentit, manente solummodo pressione quadam in latere dextro. Post mensem rursus fit gravida, & in Dec. 1721. filiam justæ magnitudinis sed mortuam parit. Ex quo tempore lecto adfigitur in mensem usque Junii hujus anni 1722. Mense vero Maii cum alvum levaret aliquando anus ipsi ita dolere ut ipsum intestinum

The bones of a foetus voided by stool. By Mr. Bern. Shiever. n. 385. p. 171. Od. Sc. 1724.

num rectum omnino excidere crederet: duobus ergo digitis prætentans & se juvare volens, extrahit cranii partem, magnitudine nummi coronæ Svethicæ, vulgo dubbel Carolin; repertis deinde in sella duabus costis, & post 14 dies abeuntibus eadem via reliquis ossibus, colore excrementitio, quæ & ipse vidi & manu contrectavi. Maritus, uxor ipsa, ejusque soror, alia non via exiisse hæc ossa mihi sancte affirmarunt, incredulo licet, & contra ordinem naturæ hæc fieri non posse strenue defendenti. Bene nunc valet, domesticis apta curis, triumque mater liberorum, qui adhuc in vivis sunt: menstruis quoque naturaliter se habentibus.

The præternatural delivery of a fœtus at the anus. By Mr. Nourse. n. 416. p. 435. Nov. &c. 1730.

XX. 2. **T**HIS Case is very like what M. Littre has given us in the memoirs of the royal academy of Paris for 1702, and as extraordinary; (viz.) where a fœtus had no other nidus than the ovary; and was brought forth through the rectum. The symptoms previous to this præternatural birth that gentleman has very faithfully drawn up; and therefore I shall give them in his words.

“ I was sent for about the middle of August last to a woman who
 “ then judged herself to be between three and four months gone with
 “ child; she had all the symptoms preceding a miscarriage, and
 “ upon touching I found the os tincæ somewhat dilated and spread,
 “ from whence I concluded a miscarriage would ensue, and therefore
 “ ordered what I thought proper to promote it; but I was some
 “ time after informed by her husband, that though she before believed she had miscarried, yet now she thought herself quick; as
 “ feeling somewhat move within her belly; agreeable to what she had
 “ perceived after former quickenings. Thus it passed on for about
 “ six or seven weeks; in which time she grew much bigger and the
 “ motion more perceptible; so that there remained no doubt of her
 “ being with child. About the third of October she was seized with
 “ violent pains in her belly and back; which daily increasing, her
 “ sister by her desire called me on the sixth; I went to her and
 “ found her labouring under very great pains, and other complaints
 “ like those preceding a miscarriage or delivery: but to be better
 “ satisfied and to strengthen my opinion I passed up two fingers into
 “ the vagina, to examine by the touch whether the os tincæ began
 “ to open and spread. I there felt a large and unusual fulness and
 “ tension, which I then judged to be the body of the uterus sunk
 “ low into the vagina and much distending it, and extending backwards and pressing against the rectum so that the excrements could
 “ not readily pass, neither could she, from its pressure upon the
 “ neck of the bladder, freely make water. I could not find the os
 “ tincæ, though I very carefully examined all about with the ends of
 “ my fingers; wherefore I then judged that the fundus uteri must
 “ have receded from its natural position, and be bent backwards towards the rectum: in which opinion I was the more strengthened
 “ from the fulness I before observed stretching backwards; and there-
 “ fore

Fig. 91.

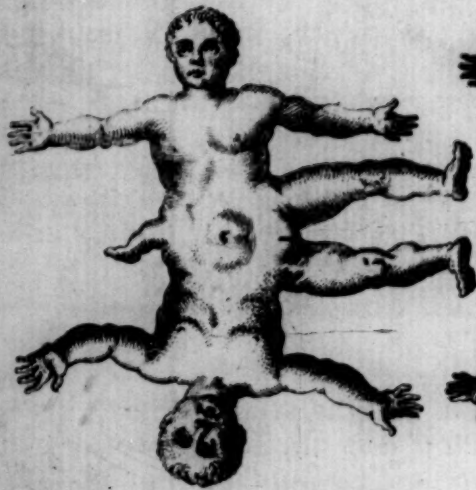


Fig. 92.

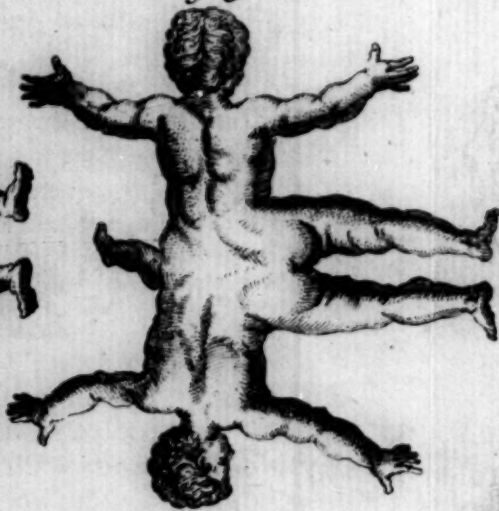


Fig. 93.



Fig. 97.

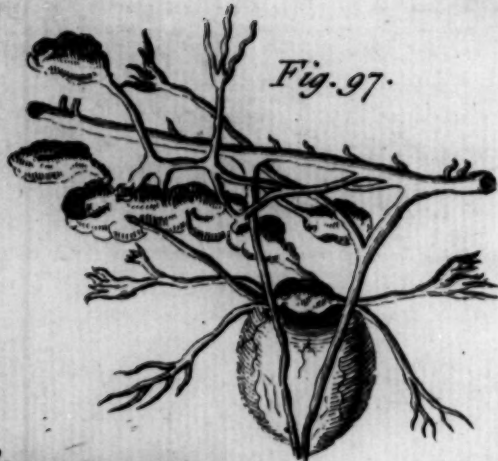


Fig. 98.



Fig. 99.



Fig. 94.

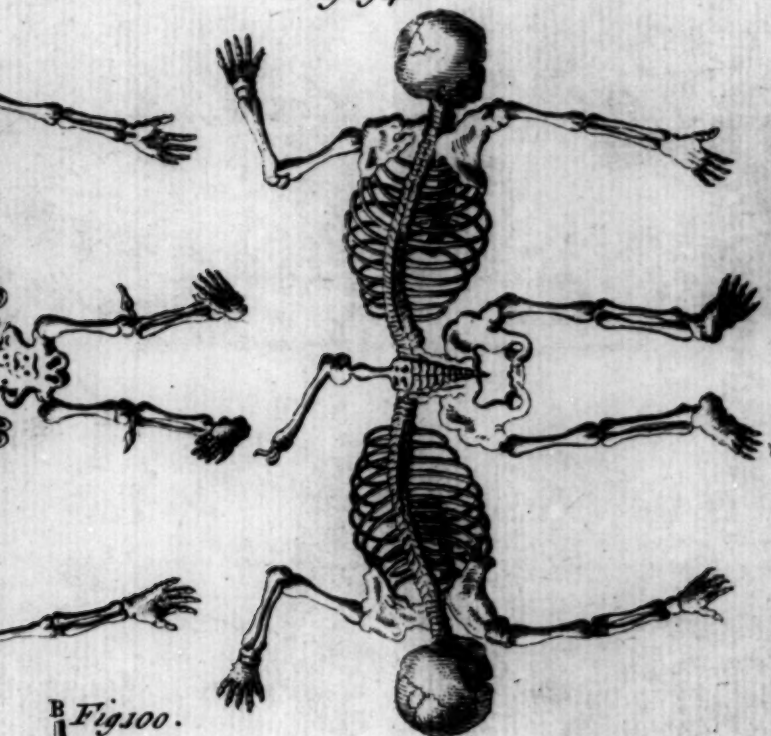


Fig. 95.



Fig. 26.



B *Fig 100.*

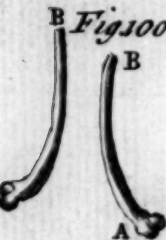


Fig. 101.

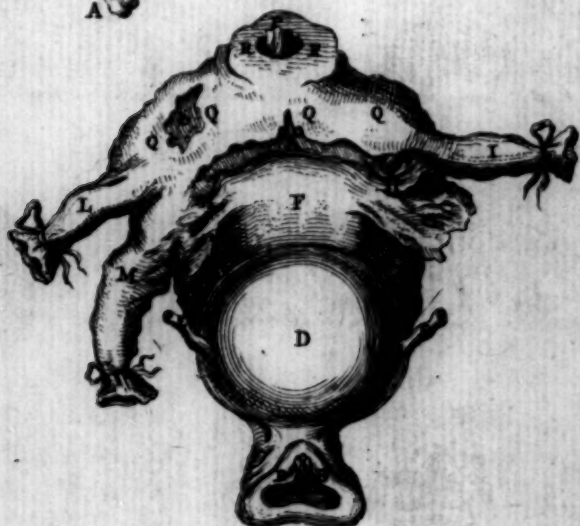


Fig. 102.



J. Mynde sculp.

“ fore concluded that the os tincæ must be very forward ; wherefore
“ I endeavoured to pass my fingers between the os pubis and the
“ fulness which pressed against the upper edge of the said bone.
“ This with some difficulty I effected, and at length about two or
“ three inches above the said bone I felt the os tincæ with the ends
“ of my fingers. The cause of this situation will more clearly ap-
“ pear in the sequel of this account. I ordered her anodyne and
“ quieting medicines to relieve her pain, which she was obliged to
“ repeat at least every twelve hours, with proper cordials to support
“ nature ; and sometimes clysters. Thus matters continued to the
“ twentieth of the said month, only that for some days before a
“ water tinged with blood came away through the anus, proceeding
“ as she believed from the piles with which she was sometimes trou-
“ bled. On the twentieth her husband came to me about six in the
“ morning, telling me that the midwife had brought away a foetus
“ but could not compleat her business ; whereupon I immediately
“ went to the midwife, who told me that a foetus was protruded
“ through the anus ; and to confirm it desired me to examine, which
“ I did immediately, and found the funis umbilicalis hanging out
“ about two or three inches beyond the anus, and passing up thro’
“ the same : I therefore passed my two fore-fingers by the string into
“ the anus, and about three inches up I found an opening, as I then
“ judged, into the uterus, wide enough to admit the ends of three
“ or four fingers, and the funis umbilicalis passing into it ; from
“ hence I was assured that the foetus came out that way. I endea-
“ voured with my fingers passed into the opening to bring away
“ the placenta ; but being very rotten it tore, so that I was
“ forced to bring it out in small pieces, and at last to leave a
“ large part of it. The septum or partition between the anus
“ and vagina was entirely whole, and no perforation through it.
“ From these appearances I then concluded that a mortification
“ must have begun in the uterus, and from its contiguity be com-
“ municated to the rectum ; so that nature endeavouring to expel
“ what was contained, and forcing it against this part already mor-
“ tified, and consequently ready to give way and separate upon
“ any pressure, produced this opening and the protrusion of the
“ foetus through it into the rectum, and so on through the anus.
“ There was a large discharge of grumous blood and other sub-
“ stances through the anus, which continued until the twenty-sixth,
“ when the woman died about three in the afternoon. I should have
“ observed that there was a fulness and hardness very perceptibly to
“ be felt outwardly in the fore-part of the belly, some distance be-
“ low the navel, from the time that the foetus came away to her
“ death ; which upon opening the body I was well assured was the
“ uterus forced upwards and forwards by a sacculus, which being
“ large and distended filled up the pelvis ; and by its bulk pressed the
“ VOL. VI. PART III. F f “ uterus

“uterus forwards. The foetus was perfect in all its parts; but much “wasted and shrunk from its being some time dead; and consequently “putrified.” This we thought necessary to premise to an examination of the parts, which upon dissection appeared as follows.

The vagina, uterus, ligamenta rotunda, left ovary, Fallopian tube and ligamentum latum on that side, together with the hypogastric and spermatic vessels on the same side, were in a natural state. The Fallopian tube on the right side we traced from the fundus uteri almost to the *morsus diaboli*; where it was confusedly united with and opened into the sacculus hereafter to be described. The ovary on this side with the ligamentum latum was dilated into a large sacculus of an irregular form, extending itself behind the uterus (to the posterior paries of which it adhered) and passing on towards the left was connected to the rectum and to that part of the colon which terminates in it. In this sacculus we found great part of the placenta and the remains of lacerated membranes, besides the aperture of the Fallopian tube mentioned before, and another about four inches in diameter into the middle of the rectum: that part of the ureter on the right side which lies between the ovary and the kidney was dilated, and so was that part of the rectum between the aperture into it and the end of the colon; both which were caused from the contents of these canals being obstructed in their passage.

Fig. 103.

Fig. 103. Shews the uterus, with the sacculus behind it, part of the colon and the rectum; the Fallopian tubes, ovary on the left side; ligamenta rotunda; and the vagina laid open to the *os tincæ*.

- A. The uterus.
- B. The Fallopian tube on the left side.
- C. The ovary on the same side.
- D. The ligamenta rotunda.
- E. The vagina laid open,
- F. That part of the colon that terminates in the rectum.
- G. The rectum continued to the anus under the vagina.
- H. The Fallopian tube on the right side, whose extremity opens into the sacculus formed from the ovary.

I. The sacculus extending itself behind the uterus; wherein we found the placenta and several lacerated membranes; and from whence there was a large opening into the rectum.

Fig. 104.

Fig. 104. Shews the inside of the sacculus and its aperture into the rectum.

- A. The intestine.
- B. The sacculus adhering to it.
- C. The opening from the sacculus into the rectum.
- D. The membranes found within the sacculus.
- E. The vagina turned to the right.

XXI. **J.** Bishop, an apprentice to a ship-carpenter in Great-Yar-mouth, about 19 years of age, had violent pains in the lower part of the abdomen for six or seven months; it did not appear to be any species of the cholic; he sometimes made bloody urine, which induced me to believe it might be a stone in the bladder. He was very little relieved by physic; at length a hard tumour appeared in the left buttock, on or near the glutæus maximus, two or three inches from the verge of the anus, a little sloping upwards; and soon after he voided purulent matter by the anus every day for some time; the tumour broke; I suspected a fistula in ano, but could not pass the probe by the orifice of the fore into the rectum. Shortly after the prongs of a fork appeared through the fore, above half an inch beyond the skin, whereupon his violent pains immediately ceased. Having divided the flesh between the prongs, and made a circular incision about them, with a strong pair of pincers and no small difficulty I extracted the fork, handle and all; it is a large pocket fork, six inches and a half long; the handle was besmeared with the excrement when I pulled it out; it is ivory, but dyed of a very dark-brown colour; the iron part very black and smooth, but not rusty. He is likely to do well in a short time, the operation having been performed almost four weeks ago; he would not own how it came, till a relation of his, on whom in a great measure he depends, threatened never to look upon him more unless he would give him an account of it; upon which he told him that being costive he put the fork up his fundament, thinking by that means to help himself, but unfortunately it slipt up so far that he could not recover it. He says he had no trouble or pain, till a month or more after it was put up.

*A fork put up
the anus
drawn out
through the
buttock. By
Mr. R. Payne.
n. 391. p. 408.
Nov. &c. 1725.*

XXII. **T** Hese stones were voided by a poor woman, per anum, on the 26, 27, and 28th of March 1723, who was then pregnant about the 11th or 12th week, according to her reckoning. I was called to her on the 23d in the night, when she seemed to be in the extremity of a convulsion fit, attended with violent vomitings; these being over she complained of great pain in her back from her reins downward to the anus; upon which I blooded her, ordered some anti-emetics, and left her: she continued with much pain the whole day; on the 24th in the night her fits returned with double force, and her pains increasing like unto labour-pains put me upon further enquiry, but nothing appeared more than ordinary; the extremity of her pain drove me to the use of clysters, but none could be thrown up, tho' the attempt was repeated by some of the most experienced nurses; I therefore gave her a gentle draught, which she observed increased her pain with a strong tenesmus, that continued near three hours before the largest stone appeared at the anus; it stopped at the upper part A D, fig. 105. but was quickly removed by pressing the lower protuberance C, whereby together with a plentiful

*Stones voided
per anum. By
Mr. D. Martineau to Sir
H. Sloane Bar.
n. 380. p. 433.
Nov. &c. 1723.*

Fig. 105.

Fig. 106, 107. tiful discharge she had ease, slept some hours, and waking with a desire to stool voided the 2d and 3d; and the next day, at four hours distance, the other two. She recovered perfectly, and was delivered of a very fine living girl, Aug. 24. It seems she had been frequently troubled, for fourteen years past, with pains in her side and stomach without vomitings; which is all she remembers.

The largeness of the stones, their seat and substance, to me seem worthy speculation; as they are all alike in colour and weight, according to their dimensions, I broke but one of them.

Weight of the stones.

Their circumference.

	oz. dwts. gr.		Inch.	A. D. the top of the stone oval.	Inch.
Fig. 105.	2 16 12	A. B. C. D.	8		6 $\frac{1}{8}$
Fig. 106.	8 12	E. F. G. H.	5 $\frac{1}{8}$	E. G.	4 $\frac{1}{8}$
Fig. 107.	7 3	I. K. L. M.	5	I. L.	3 $\frac{1}{8}$
Fig. 108.	7 12	N. O. P. Q.	4 $\frac{1}{8}$	N. P.	3 $\frac{1}{8}$
Fig. 109.	5 13	R. S. T. U.	4 $\frac{1}{8}$	R. T.	4 $\frac{1}{8}$

Fig. 110.

Fig. 110. A shell taken off the stone at the end 2. The stone and shell being like a chesnut soft and like wooll, cutting into the stone at 3, I found it hard.

Vast numbers of stones voided by urine, during the use of the Pyrmont waters. By Dr. Abr. Vater. p. 377. p. 322. May 31. 1723.

XXIII. 1. **N**obilis Pomeranus, sanus ac vegetus, nulliusque mali sibi conscius, tres abhinc annos suasu amici socium se ipsi adjunxit, in bibendis aquis Pyrmontanis. Factum autem est ut, cum potando aliquot dies transgisset, calculos quosdam minores, absque ullo quidem dolore, excludi inter mingendum sentiret. Effectum hunc criticum esse sibi persuadens noster aquas largiore dosi bibere incipit; quo facto quatuor vel quinque dierum spatio ultra quadraginta calculi, etiam sine molestia, exierunt. Hoc viso strenue & alacriter potare continuat, optimum hujus curæ effectum sibi promittens. Assumpta vero nimia aquæ quantitate urina supprimitur, adeo ut ne minimam ejus portionem per tres dies emittere potuerit, usquedum catheteris ope via aperiretur. Commonefactus itaque à medicis ab usu aquarum ulteriori abstinuit, rem peractam esse credens. Non ita multo post iter faciens continuo mingendi conatu lacessitur, ac iterum iterumque ex rheda descendere cogitur, tandemque inter gravissimos dolores sanguinem purum effundit. Duravit miæus cruentus & dolorosus quamdiu æger in itinere fuit, postquam vero domum reversus quieti studuit statim cessavit, nec quicquam doloris remansit. Quoties vero ab illo tempore sive rheda sive equo veheretur rediit dolor & sanguis cum urina secessit, sed quiete restituta iterum evanuit, nullo planè dolore superstito. Contigit quidem interdum ut calculus unus vel alter prodiret, rarius tamen hoc factum est, nec ullum inde dolorem percipiebat æger, quoniam hi longè minores erant quam quos inter aquarum usum reddiderat. Symptomate hoc admodum molesto per duos integros annos vexatur æger, tandem usu medicamentorum liberatus est. Cessante itaque penitus miæu cruento nil amplius timuit, sed

sed integræ sanitati restitutus, ut ipsi videbatur, medicamentis valedixit. Augetur post illud tempus indies stranguria; vir continuo diu noctuque ad urinam reddendam stimulatur, quo malo & ad hunc usque diem affligitur. Urina, quæ parcissima quantitate summoque cum dolore emittitur, crassa exit, ob pituitam viscidam admistam quæ fundum statim petit, glutini ex farina confecto similis, tantæque tenacitatis ut in fila quasi duci queat. Æger interea appetitu bono gaudet, & somno quoque sufficienti utitur, nec ullibi præterea in corpore dolorem sentit.

Quisquis historiam morbi accuratè perpenderit mecum confitebitur vix ei parem inter observationes medicas inveniri. Notatu dignissimum imprimis est potu aquarum istarum mineralium calculos sat insignes, in tanta copia, atque intra tam breve temporis spatium exclusos esse a viro qui ante aquarum usum perfectè sanus erat, nec ullum calculi indicium unquam senserat. Non levem hoc excitare potest suspicionem calculos non tam ab aquis propulsos quam ex croco minerali, qualem aquæ tales medicatæ in sinu gerunt, generatos fuisse. Parum quidem huic sententiæ favere videtur tempus admodum breve tot calculorum concretioni vix idoneum, quoniam hi paucos post dies ab inchoato aquarum potu exclusi sunt. Non tamen existimo quenquam facilè definire posse quantum temporis spatium ad calculi in corpore generationem requiratur; poterit hoc forte esse exiguum. Longè enim minus veritati consentaneum videtur calculos istos jam tum in viis urinariis latitasse, quoniam vir ille nunquam antehac urinæ difficultatem aut aliud calculi signum perceperat. Confirmant e contrario omnes hujus casus circumstantiæ, concretionem istam subito factam esse. Calculi enim ipsi nullatenus asperi atque angulosi, sicut alias vesicæ calculi esse solent ob successivam spiculorum salinorum cohæsionem, sed pisorum majorum minorumque instar, rotundi, glabri, & politi observantur; quod coagulationem eorum subitanæ docere videtur. Color eorum luteus convenit exactè cum sedimento illo coctione ex aquis Pyrmontanis extracto, cujus minimam portionem ex quatuor unciis aquæ hujus paratam addere volui, ut tanto melius convenientia ista patefcat. Fracti calculi strata ejusmodi variegata interius monstrant qualia in tophis thermarum Carolinarum deprehenduntur, quorum pariter particulam exiguam adjeci. Addidi propterea quoque calculos duos, cum aliquot frustulis contritorum, paucissimos enim tantum obtinui. Ultimo tandem loco notari quoque meretur singularis ista circumstantia, quod maxima horum calculorum pars inter ipsum aquarum usum exclusa sit, post illud tempus vero rari longeque minores prodierint. Non tamen ideo culpa in aquas istas conjicienda erit, quasi hæ ad calculi generationem disponant, cum potius debilitati viscerum ac pravæ digestionis adscribi debeat effectus ille extraordinarius. Nolo etiam levissimas has conjecturas pro veritate indubitata venditare, rem potius integram illustrissimæ societati decidendam relinquo.

A large stone voided by a woman thro' the urinary passage. Communicated by Dr. Richard Beard. n. 397. p. 211. Jan. &c. 1727.

XXIII. 2. **A** Poor woman in the parish of Fladbury in Worcestershire, aged sixty three, about three years ago was afflicted with the usual symptoms of a stone in the kidneys, and afterwards in the bladder. The fits of pain occasioned by it increased with its bulk till she was so emaciated that her case was judg'd desperate. Finding relief (towards the end of last summer) by a plentiful use of mallow-tea she persisted in it for a while; when on a sudden in the presence of some women, she perceived an uncommon weight and force within, which assisting with all the strength and breath she had left a stone came away with a noise that very much surpriz'd the whole company, and with less pain and effusion of blood then, or soreness afterwards, than might have been expected. She is since easy and in health, and feels no other inconvenience now but that unavoidable one, an incontinentia urinæ.

Fig. III.

The Stone (of which I send you the side-view drawn as near the truth as we could) is of the same colour and texture with others of this kind that I have seen formed in human bodies. Its weight at present is $\frac{3}{4}$ ij. 3 j. 55 gr. avoird. When first voided 'twas considerably more, several pieces having been rubb'd off at *c c*, and likewise on the other side: The greatest circumference is 7 inches and $\frac{1}{2}$; 'tis 4 inches $\frac{1}{4}$ round at the thickest place, and the length on the convexity is 4 Inches $\frac{3}{8}$; the parts of the stone at *a a a* are somewhat jagged and stain'd with blood, as is the little protuberance on the opposite side *b*. Here I suppose it met with the greatest resistance at the time of its expulsion thro' the urinary passage.

An account of a stone dissolved in the bladder and discharged through the urethra. By Dr. Laur. Heister to M. de Thom. n. 417. p. 13. Jan. &c. 1731.

XXIII. 3. **I**N cœnobio seculari, quod Marienthal appellatur & ad horæ circiter distantiam ab Helmstadio situm est, rerum œconomicarum hujus cœnobii præfectus est vir nomine Widmannus, sexagenario major, sed robustus & duro vitæ victusque generi adsuetus, qui per plures annos primo renum calculo sæpe & vehementer laboravit, eorumque sensim magnam copiam, quorum multi pisi magnitudinem superabant, per iter urinæ haud sine magnis doloribus excrevit. Tandem vero quatuor ab hinc annis calculi quoque vesicæ omnia percepit symptomata, ita ut sæpe non sine maximis cruciatibus in pubis & perinæi regione urinam excernere potuerit. Tandem vero anno 1728, postquam aliquamdiu variis usus erat remediis, & imprimis tinctura antinephritica Lipsiensi sive Rothiana, atque simul cerevisiam illam his in regionibus contra calculum celeberrimam, quæ Regiæ Lutteræ vulgo *Königs-Lutter*, oppido Brunsvicensi, coquitur, & quam *Duchstein* appellant, hancque ob causam in loca sive urbes remotissimas devehitur, continuo pro potu ordinario hauserat, aliquando vehementes inter mingendum dolores, nisum & constrictionem in vesica, sensumque eo ipso ac si calculi in vesica frangerentur ac dissilirent percepit, eoque ipso mox aliquot frustula calculi fracti cum lotio dejecit, quæ deinde per plu-

res dies alia secuta sunt, donec tandem ab eis liberatus bene atque pancreatice ab omnibus & calculis & calculi doloribus immunis nunc vivat. Calculos plures unà in hoc viro fuisse, majores quam ut integri per urethram transire possent, docet primo diversus color diversorum frustulorum, quorum nonnulla fuscum obtinent colorem, alia flavescentem ad sulphuris colorem aliquo modo accedentem, quemadmodum ex adjectis frustulis perspicere est. Deinde id evincunt diversa horum frustulorum segmenta, quorum alia majoris alia minoris arcus segmenta sunt. Quod ad numerum attinet frustorum, centum circiter ejusmodi mihi dedit, qualia nunc offero, quæ ex matula collegit. Sancte vero mihi affirmavit magnam eorum copiam periisse, cum sæpe ruri, vel in sylvis, vel in stabulis ad res domesticas curandas degens, multa cum urina vel in terram, vel inter herbas aut stramina ejecerit. Nonnulla horum frustulorum dimidium pollicem æquant, plura minora sunt, eorumque superficies externa convexa, interna in plerisque concava, alia nucleum, ut vocant, calculi adhuc exhibent. Ex segmentis frustulorum valde convexis quæ hic mitto & quæ adhuc adservo judicare licet vix ullum illorum calculorum nucem moschatam superasse, plures vero minores fuisse.

XXV. **N**ihil fere quam in Pelvi renali & in vesica calculos invenire frequentius: At quis unquam in ipsa urethra calculum ponderis unc. quinque cum semisse invenit? en ideo casum plane mirandum.

Viginti abhinc annis penis cujusdam Cookworthy ob luem veneream ad modum quasi eunuchi Turcici resectus fuit, at vulnus nec probe curavit chirurgus nec bene sanavit; cicatrice quippe obducta vix ullum urinæ iter, urethra pene occlusa. Lotium exinde exiguisimo rivulo summoque nisu reddidit; brevique inter mingendum cruciatus magnus accessit; pauloque post in media et suprema parte scroti tumor parvus, sensim tamen auctus in magnam demum excrevit molem, lævum ad inguen quasi vergens. Hinc urinam ejaculandi impotens prorsus factus stillicidio ejus continuo laborabat. Enatis etiam tribus quatuorve in scroto fistulis, pars forte maxima lotii ex hisce defluebat, pure subinde comitante. At ne sic quidem tumor, jam durus admodum, vel minime decrefcebat, quinimo increvit usque. Per plures jam annos miser hic neglectus omnino ad Plymuthi nosocomium tandem delatus est. Ibi quum summo nixu urinam, solito quod dixit ardentio rem, expellere corpus incurvando maxime contenderet, ingens hic prolapsus est calculus, qui recens excretus uncias quinque cum semisse ponderis avoird. pependit. Eum mihi propere, quasi monstrum quoddam, miserunt nosocomii rectores. Rem certe quod debui plane mirabar, hominemque invisi continuo, lacerum inveni scrotum, jam minime tumidum, manum puerilem facile admit tens, & ex urethra calculum elapsum fuisse deprehendi. Atqui id forsan haud parum miraculo adjiciat, quod magnum hoc lacerumque vulnus balsamo quodam terebinthino tantum oblitum brevi sanum eva-
sit,

*A large stone
formed in the
urethra. By
Dr. J. Huxham
to Dr. Ratty.
n. 413. p. 257.
March 31.
1730.*

fit, nisi quod parva adhuc pateat urinæ fistula in superiore parte scroti. Atque miscellus ille, cui ante excretionem calculi vix ulla se movendi potentia, commode jam satis obambulat. Non ego quidem hunc calculum in urethra primitus fuisse enatum autumo, at ibidem ex arenosa materia concretum. Cum enim parvus forte calculus, semen quasi hujus enormis, è renibus delapsus ob urethram fere occlusam in canaliculo substiterat, sabulo perpetim appellente auctus in immensam hanc molem tandem excrevit.

Observations upon dissecting the body of a person troubled with a stone. By Dr. Perrot Williams. n. 377. p. 326. May, &c. 1723.

XXV. 1. **M**R. Bowen of Haverford-West, aged between forty and fifty, having been for about seven years severely afflicted with the usual symptoms of the stone in the kidneys and bladder, viz. bloody urine after exercise, strangury, &c. dy'd in May 1722. His body being opened there were found in the bladder six smooth oval stones, exactly of the same figure and nearly of the same magnitude: There were also three cells in each kidney, the figure of each suitable to that of the stones: The ureters were so præternaturally extended, as very easily to admit the largest of the stones to pass from the kidney to the bladder. The viscera, &c. appear'd in their natural state.

By Dr. Abr. Vater. n. 394. p. 102. May &c. 1726.

XXV. 2. **J**Uvenis studiosus per duos annos dysuria frequenti laboravit, quorum plerique sine insigni dolore inter mingendum secesserunt; quidam tamen eorum reliquis majores, pisorum majorum vel phaseolorum magnitudinem habentes, in urethra substiterunt ac manu chirurgi comminuti aut sectione extracti sunt. Incidit hic sensim in marasum totius corporis, ac urgente tussi sicca & asthmate, accedente insuper tumore pedum œdematoso, tandem lecto affixus est, ac postridie animam redidit. Corpore secto in thorace pulmonem cum pericardio, diaphragmate & costis hinc inde concretum, ac in dextro præprimis latere scirrhosum invenimus; in utroque præterea ventriculo cordis polypos insignes, qui truncos vasorum occupaverant, & proculdubio asthmatis atque insequentis suffocationis, mortisque subitanæ præcipua causa fuerunt. In abdomine hepar & lien nullo manifesto vitio laborabant; intestinum autem ileon sugillatum erat, & colon in toto suo ambitu, à dextro inde latere ubi hepatis accumbit, unà cum recto, ita constrictum & contractum apparebat ut vix digiti crassitiem æquaret, nullamque ferè cavitatem interiùs monstraret. Tandem vias urinarias utpote officinam tot calculorum visitantes, in renibus atque ureteribus nihil præternaturalis invenimus, in vesica verò tres calculos, phaseolorum magnitudinem habentes, eos tamen non liberos sed membrana valida involutos ac lateri anteriori prope sphincterem adhærentes deprehendimus, quos in rei memoriam una cum eorum involucro asservo. Unde hæc membrana calculos involvens originem trahat explicatu difficillimum mihi videtur; quamobrem hac data occasione statu per ureterem utrumque immisso inquisivi, an illa membrana cum ureteribus communicet; & utrum sit ipsa membrana,

membrana vesicæ interior à calculis in ureteribus, inter substantiam vesicæ incedentibus, una cum uterere, vel hoc rupto extensa: sed nihil detegere potui. Hos tamen calculos Dysuriæ non tantum continuæ, sed etiam propter irritationem perpetuam, constrictionis præternaturalis intestini coli atque recti extitisse rationi conveniens videtur.

XXV. 3. **A** Man aged 70 years died of a suppression of urine, occasioned by a stone stopping in the urethra, just within the glans, of the bigness of a horse-bean. This appearance, with the symptoms that had attended this miserable man, gave me reason to expect something remarkable in the urinary passages. The ureters and pelvis were very much distended; which is common where great numbers of stones have descended down them, from the kidneys to the bladder. The bladder contained about sixty stones, the largest of which was about the size of a walnut, the others smaller; and just within the neck was a hard tumour as big as a nutmeg, which almost closed the orifice: and indeed the situation of this tumour was such that it not only made the passing the catheter very difficult, and hinder'd our feeling the stones by directing the instrument upwards; but likewise would alone produce the symptoms of the stone in the bladder, by obstructing the free discharge of urine thro' the urethra; the inner membrane of which appeared as if lacerated in several places, and the tube filled with a glutinous matter tinged with blood. On the back part of the vesiculæ seminales near the prostata were several stones as large as pease, which closely adhered to the adjacent membranes.

*Observations
on the body of
a man troubled
with the stone.
By Mr. J.
Ranby, n. 401.
p. 413.
Jan. &c.
1728.*

XXV. 4. **H**omo septuaginta circiter annorum ventris dolore horrendo correptus est die Oct. 19. 1722. Accesserunt vomitus & urinæ difficultas: præ doloris atrocità sese erigere non poterat, sed misere incurvatus dies noctesque prope focum jacebat ejulans. Sexto morbi die, urinâ prorsus suppressâ, de dolorosâ circa hypochondria stricturâ, perinde ac a funibus circumjectis, queri cœpit, postea de pondere quodam in vesicâ molesto, quasi rapi majoris (sic aiebat) inibi hospitantis. Omnibus in pejus ruentibus die morbi duodecimo ad plures abiit. Cadavere aperto vesicam secuimus, quam vel a minimis calculi vestigiis immunem invenimus; in utroque autem rene (multâ aquâ refertis) repertus est calculus insignis, scaber & multiplici ramo per parenchyma se dispergens, quem integrum extrahere nullâ arte potuisses nisi totâ prius frustulatim decerptâ carne. Ramorum maximus in ureteris caput se insinuans adeo id occupaverat ut ampulla obturamento suo arctius occludi vix posset. Ulterius scrutari nobis non licuit, ideo unum tantum addam, nempe quod omentum instar fasciæ angustioris sub hepate retractum delitescibat. Pauper erat & corpore athletico, semper sanus, nisi quod a paucis annis aliquando fabulosa per urinas excerneret.

*—By Dr. P.
Hardisway to
Dr. W. Stuke-
ley. n. 377.
p. 327. May
&c. 1723.*

Fig. 112, 113.

XXV. 5. **M**R. Laurence, a gentleman of about forty years of age, had for near twenty years a complaint in his

*Stones found
in the kidneys.
By Mr. Do-
byns, n. 402.
p. 452. Apr.
&c. 1728.*

kidneys; making bloody urine upon any extraordinary motion, but free from the great pain and all other symptoms usually attending nephritic cases. Upon opening the kidneys after his death, there was found in each a stone of an extraordinary size and figure, besides one hundred smaller, which are brought for the view of the society, with a description and draught of the two largest.

Fig. 114.

Fig. 114. Shews the stone denudated, as taken from the pelvis of the right kidney.

- a. That part which had branched into the ureter, and totally obstructed its channel. *b. b. b.* The eminent parts of it. *c. c. c.* That part which fill'd the capacity of the pelvis.

Fig. 115.

Fig. 115. Shews the stone taken from the left kidney.

- a. That part which had protruded it self into the upper part of the ureter, but did not totally plug it up, by which means the urine had a passage. *b. b. b. b.* The eminent parts which branch'd into the fistulæ membranaceæ. *c. c. c. c.* The body of the stone which lay in the pelvis of this kidney.

*A new method
of cutting for
the stone. By
Mr. J. Dou-
glas. n. 371.
p. 83. Apr.
1722.*

XXVI. **E**Ver since I was anatomist and surgeon enough to reason upon the causes of the tediousness and bad success of the common methods of cutting for the stone, I concluded that they were principally owing to the natural structure and situation of the parts concerned. Therefore I began to consider why that operation might not be performed the high way so frequently mentioned by authors, but never approved by any except Fr. Rossetus the most sagacious of all surgeons, who has certainly been very little read or very ill understood, else this operation had not been so long a secret. After making some experiments on dead bodies, I was convinced that the stone might be extracted that way with a great deal less trouble than by the common one; and I was persuaded that the wound would heal again by the many authentic instances we have of accidental wounds in the same place being speedily and firmly cured; and therefore I resolved to make the experiment on the first patient I could meet with, which I could not procure till Dec. 1719, and then I proceeded as follows.

The patient was laid flat on his back upon a table, with a pillow under his head, his wrists and ancles being fastened together, with straps. Then I ordered one assistant to his head, another to each of his shoulders, two to the penis, one of which was to manage the ligature and the other the prepuce, and one to each knee to hold them as fast as possible. The patient and the assistants being thus plac'd, the operation consists of three parts.

- Fig. 116, 117. First, In filling the bladder which is done thus: pass the catheter fig. 116. draw out the stillet fig. 117. and order the ligature-assistant to cast the ligature, which is a skein of silk, round the penis above the glans. Fix the key fig. 118. to the head of the catheter fig. 119. to keep it steady while you screw on the syringe fig. 120. and screw the

Fig. 103.

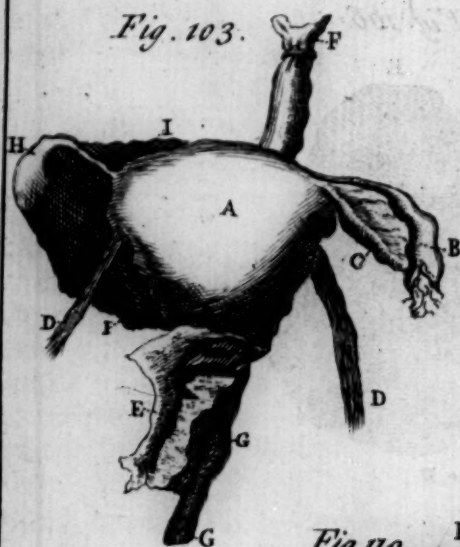


Fig. 104.



Fig. 105.



Fig. no.



Fig. 109.



Fig. 111.

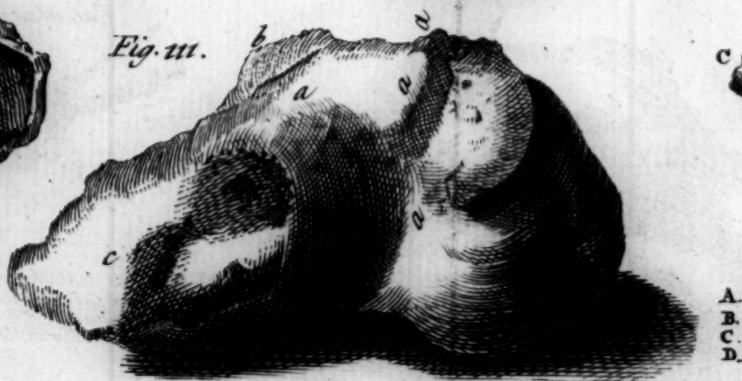


Fig. 114.



Fig. 115.

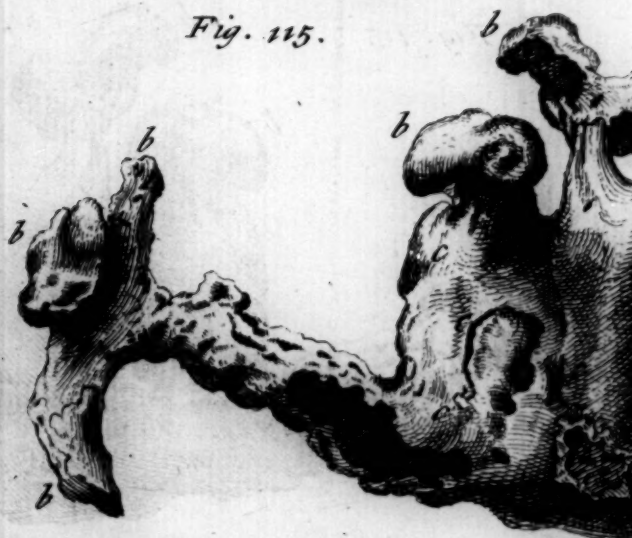


Fig. 106.

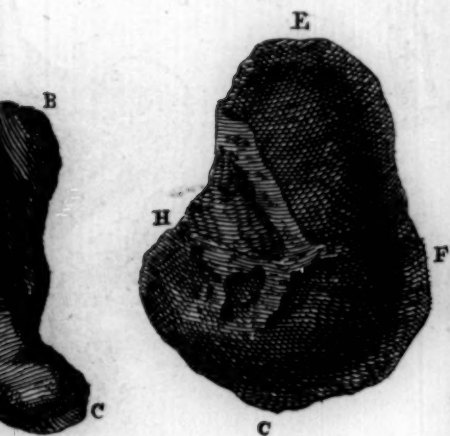


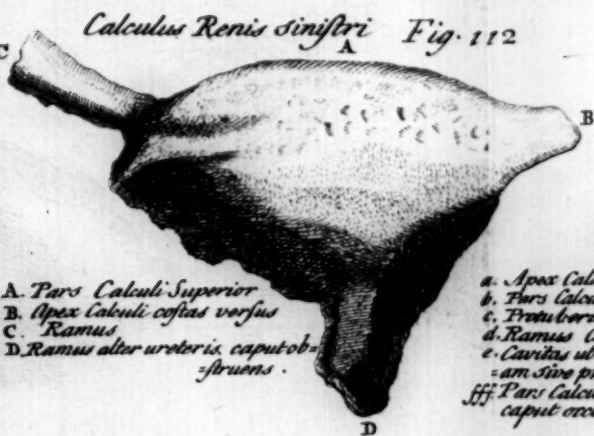
Fig. 107.



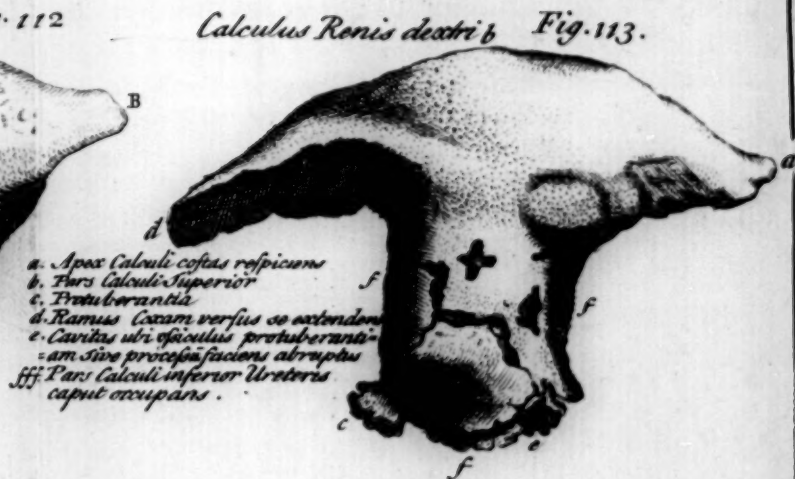
Fig. 108.



Calculus Renis sinistri Fig. 112



Calculus Renis dextri b Fig. 113.



A. Pars Calculi Superior
B. Apex Calculi costas versus
C. Ramus
D. Ramus alter ureteris, caput ob-
struens.

a. Apex Calculi costas respiciens
b. Pars Calculi Superior
c. Protuberantia
d. Ramus Coxam versus se extendens
e. Cavitas ubi facculus protuberantia-
am sive processum faciens abruptus
fff. Pars Calculi inferior Ureteris
caput occupans.



the second part of the sucking-pipe fig. 121. to the first fig. 122. Fig. 121, 122. Then order the penis ligature to be straitned, and the prepuce assistant to gather the prepuce up about the catheter and to hold it as close as possible. Then order the water, being a little warmer than milk, to be clapped under the sucking-pipe, and having drawn it up into the syringe thrust it into the bladder leisurely, till it is so full that you can perceive its tumour through the abdomen, (at which time you will also observe the penis above and the prepuce below the ligature very much swelled, and the patient in a great deal of pain) which is a certain sign that there is enough injected; then withdraw your syringe and catheter together, taking particular care that your penis assistants straiten their gripe, lest the water should follow the catheter which would undo all.

Secondly, in making the incision, which is done thus: Order the penis assistants to turn the penis towards the anus that so their hands may be the more out of the way; take the first knife fig. 123. and cut at leisure and with a steady hand, from near the upper part of the tumour of the bladder, or lower according to the supposed bigness of the stone, down to the os pubis and exactly in the middle; when you are got a little more than half way through the abdominal muscles, take the second knife fig. 124. clap its back on the middle of the os pubis and run its point down towards the sphincter untill you get into the cavity of the bladder, which is discovered by the issuing out of the water, then run your knife along very quickly towards the fund of the bladder as far as is necessary. Fig. 123. Fig. 124.

Thirdly, In extracting the stone, which is done thus: Before you withdraw your knife introduce the fore and middle fingers of your left hand into the bladder between the knife and the os pubis; then withdraw your knife and thrusting the fore and middle fingers of your right hand into the anus raise the stone up towards the wound, and so you will easily catch hold of it, though never so small, with your fingers which are in the bladder; draw it out with the smallest end foremost, and introduce your fingers again to feel if there are any more stones, and draw them out as before.

The operation being over, with a needle and thread make one stitch through the skin in the middle of the wound, and tie it pretty close; undo the straps and carry the patient to bed. My patient being put to bed I laid a pledget arm'd with balsam over the wound, and a bit of sticking plaister over that. Then I embrocated all the abdomen, scrotum and penis with warm ol. chamæmel. over the dressing and all the abdomen I applied an emollient pultice, spread almost an inch thick on soft flannel; then I turn'd a swath a little broader than the patient's hand once round him, and pinned it on the pultice cloth, just tight enough to keep it on. As soon as he was dress'd I gave him an opiate (for nothing is so proper as rest) such as this $\mathfrak{R}$ aq. cinnam. hord. $\mathfrak{z}$ ii. laud. liq. gutt. xv. syr. de mecon.

mecon. ζ ii. which may be increased or diminished as the case requires. Next evening I took off the pulice and dressing and cut the stitch; then fomented the wound and all the abdomen with stupes wrung out of aq. calc. and fresh urine, as warm as he could bear it, and dress'd the wound as before. Then I rubb'd all the scrotum, penis, and groins with unguentum album, to prevent their being scalded by the urine which flows from the wound. The wound must be dress'd twice a day at least, till you have a plentiful digestion. After every dressing the ointment and oil was used, as before directed. There is little variation in the dressing of the wound, except what is common in others. The urine flows always through the wound, untill the wound of the bladder is cured, which is sooner or later according to the constitution of the patient. When the urine begins to come the right way, it pains and scalds them much after the same manner, as when they had the stone, (which is caused by the contraction of the urethra that has been so long usefess,) but it never lasts above a day or two, and then they make water with the same ease as any other person. They ought not to be forced to go to stool under six or seven days, unless there is some particular reason for it, because straining to go to stool injures the wound. They ought never to be taken up, except to have their beds made, until the urine comes all the right way, because it makes them sick and faint; and consequently hinders the cure of the wound. Cold is to be carefully avoided, because it puts them to a great deal of pain either to stifle it or to cough out. If a flexible catheter could be passed and kept in the passage without pain, it would very much hasten the cure of the wound.

I made this operation the first time Dec. 23. 1719. upon a boy between sixteen and seventeen years of age, and in five weeks time he was perfectly cured. The stone was of the figure and bigness of fig. 125. I made the second operation May 12. 1720. on a boy of eight years of age, and in six weeks time he was perfectly cured. The stone was of the figure and bigness of fig. 126. The third patient was but three years of age, and was cut in Aug. 1720. but died of convulsions about 15 hours after the operation. Fig. 127. Shews the form and bigness of his stone. The fourth operation was made March 23. 1720-21. upon a boy about fourteen years of age, and in four weeks afterwards he was perfectly cured. This stone is represented in fig. 128. In this patient I made a small wound in the peritonæum through which I saw the guts present, but I pushed them back with my finger and stitch'd the skin, and we had no farther inconveniency by it. These three patients have been already shew'd before this society. This operation may be perform'd with equal success on females, when the stone is large, but if it be small the common way of extracting them is very good.

From all which I think I may safely conclude in the words of the inimitable Rossetus.

“ Post

Fig. 125.

Fig. 126.

Fig. 127.

Fig. 128.

“ Post hæc nemini dubium esse debet novam hanc nostram cystotomiam veterem illam tot doctissimorum chirurgorum cystotomiam (tam periculosam, ut eam aggredi vel ipse Hippocrates chirurgon chirurgotatos metuerit) & leniorem & tutiorem haberi.

XXVII. Q. 1. **W**Hether it is not possible in some measure to relieve those persons (who by reason of their great age, bad habit of body, &c. cannot submit to any of the great operations for the stone with tolerable hopes of success) by making an artificial fistula in the perinæum?

A. That a great many patients offer, both young and old, who are afflicted with the stone in the bladder, and whom we cannot with any tolerable hopes of success advise to submit to the great operations for the stone, daily experience shews. It is inhuman to cut them, and shews a very great imperfection in our art to say we can give them no relief. Is there no medium yet found out between living in extream misery and submitting to a desperate operation? Yes; Thomas Fienus about 125 years ago proposed a palliative cure for such patients, where a radlicative cure could not be expected; an operation which may be performed with safety on the most ancient; the wound is so small and the parts cut of so little consequence to life. An operation by which we can prevent or alleviate the most lamentable effects of the stone; viz. the total suppression of urine and the cutting pains they endure in and after making water, &c. yet this operation has been as little minded all this while by the hospital-lithotomists, as Rosset's most excellent treatise before I introduced the hypogastric section in 1719. Tho' I admire Fienus's design in making this fistula, yet I can by no means approve of his way of doing it. It ought to be performed thus: place the patient as in Marianus's operation; pass a staff into the bladder, and cut the skin and fat until you lay that part of the urethra bare which reaches from the prostate gland to the cavernous urethra; then make a small incision into it with the point of your knife, withdraw the staff and pass a small flexible cannula into the wound of the urethra; then dress the wound s. a. extract the cannula, clean it and introduce it again every dressing, that so you may leave a fistula in the room of the wound. Through this fistula the patient himself or any one about him may easily pass an oiled probe, and push the stone back whenever he finds himself attacked with a suppression of urine, or when the stone presses hard against the sphincter in endeavouring to make water; which otherwise could not be done without the ceremony of sending for a surgeon, and staying in misery till he comes to pass the catheter, which in such cases is not always to be done without a great deal of pain, and sometimes danger. By this fistula we can also very easily inject any liquor that may be thought proper either to prevent or allay the inflammation of the bladder, or cleanse it from the gravel, or any other sort of filth that may collect there, by which the increase of the stone will be prevented, &c.

Two chirurgical questions stated and answered. By the same.

n. 399. p. 318.

July 1727.

In females all those advantages are obtained by the natural streightness and shortness of the urethra, whence they never suffer the tenth part that males do; which is an incontestable evidence that when the passage into the bladders of males is made as streight and near as short (as is done by the forementioned fistula) they will reap the same advantages.

Q. 2. Whether it is not possible to dilate the artificial fistula in the perinæum of males, and the urethra of females with sponge or gentian-tents gradually increased for some time to such a width, that we may easily pass a pair of forceps into the bladder with which the stone when small may be extracted, and when large, or of an irregular figure, broken, and the pieces extracted gradually and at different times, when they cannot be extracted at once, without fatiguing the patient too much?

A. To prove that both these fistulas may be dilated to a sufficient bigness by the means proposed, (especially if the parts are frequently bathed in a semicupium or otherwise as the operator shall think proper, and some warm oil injected into the fistula every time the tent is changed, the better to supple and relax the parts) I shall only make use of three arguments; 1st, common experience shews to what a great width fistulas in all other parts of the body, though very small at first, may be dilated by sponge or gentian tents. 2dly, Nature herself without any art has frequently performed this operation on both sexes; in males who have been cut for the stone after the old way, and had fistulas remaining in perinæo, it is often found that some considerable time afterwards stones of no small size have appeared which had made their way thro' the sphincter of the bladder into the membranous urethra and stuck near the orifice of the fistula, whence they were easily and safely extracted. I saw a stone lately as big as a puller's egg that was expelled from the bladder of a young woman without any help, as her physician assured me, and she had no inconveniency afterwards, which certainly would have happened if it had been extracted after the common violent method. In the Phil. Transf. n. 397. Dr. Beard of Worcester gives an account of a yet larger stone, that passed after the same manner†, but she had the common inconveniency afterwards, viz. an incontinency of urine, owing more to the roughness than the bigness of the stone that had lacerated the parts as in the common operation, which might have been prevented had she been assisted in time as above. 3dly, M. Collet in his *Traité de la Taille* gives an account of a gentleman on whom he performed this operation three different times, and extracted in all ten stones. His words follow: "Enfin M. Usson
" *étant hors de danger & sa playe prête a se cicatrifer, prévoyant*
" *bien ce qui pourroit arriver dans la suite je lui conseillai de tenir sa*
" *playe ouverte, pour y entretenir seulement une petite cannule, qui*
" *dans l'occasion donneroit une entiere liberté de faire injection pour*
" *nettoyer*

† Vid. sup.
§. XXIII. 2.

“nettoyer la vessie de toutes les immondices & pour qu'on pût en-
 “lever les nouvelles pierres qui pourroient se former. Il prit ce
 “parti, & il se trouva bien durant cinq années qu'il a vecu depuis
 “avec assez de santé. Mais a trois différentes reprises je me suis vu
 “obligé de lui tirer jusqu'à dix autres pierres qui s'étoient formées
 “dans la vessie : une petite tente d'éponge préparée mise pendant
 “quelques heures dans la fistule à la place de la cannule me facili-
 “toit l'entrée d'une tres petite tennette. M. Usson s'habilloit dans ce
 “moment & il sortoit pour aller par tout ou ses affaires l'appelloient.”
 I myself know a gentleman that now keeps a fistula in perinæo open
 for the very same reasons.

Since then it is evident that fistulas in all parts of the body are dilatable to a great width, since nature is often able of herself to dilate the very parts in dispute to an extraordinary degree; and since the very operation I here propose has been successfully performed three times on the same person; therefore an artificial fistula in males, and the urethra in females may be dilated so as to extract any stone without cutting the body of the bladder, or lacerating any of the parts. This operation will appear much less surprizing if we consider that it is only dilating the sphincter of the bladder, &c. in a different manner from that daily done in Marianus's operation. By this method the parts are dilated gently and gradually, after being well bathed and anointed the better to relax them: whereas in Marianus's operation they are dilated quickly and violently, and then the stone, be it of what largeness or figure soever, is forcibly drawn out immediately; whence contusions, lacerations, hæmorrhages, inflammations, mortifications, &c.

CHAP. VI.

AFFECTIONS of the BONES and JOINTS.

- I. **S**OME years ago I communicated to the royal society my observations upon the bones; since which time I have frequently employ'd my thoughts upon the same subject, and have found that the superficial part consisted of an inconceivable number of small vessels and some few of a larger size; which last when they came to the surface of the bone appeared to be cloathed either with a membrane or a bony substance perfectly transparent. I once discovered in a small portion of a shinbone four or five vessels, of such a size that a single filament of silk might have been drawn thro' their aperture.

Observations upon the bones and the periosteum. By Mr. Leeuwenhoeck. n. 366. p. 91. Sept. 31. 1720.

ture. One of these appeared to consist of two openings, each of which seemed to be provided with a valve, which was so disposed as to let out the contents of the vessel, but suffer nothing to go into it. In all my observations upon the surface of the bones I never, but this once, discovered so many of these vessels in so small a compass. As for that matter which issues from the bone and is carried into the periosteum, I have discovered the source of it to be the spongy or cellular substance on the inside of the bone, which is the repository for the marrow. This spongy substance consists of long particles closely united and linked together, and composed of an infinite number of small vessels, some running lengthwise, and others taking their course towards the sides of the bony particles. These bony particles, notwithstanding their great number of apertures, are yet exceeding hard, and lie some of them parallel, and others perpendicular to the length of the bone. Those particles that lie perpendicular to the length of the bone have vessels proceeding from their ends, and from their sides where they do not lie close together proceed other vessels that compose the cortex, or superficial part of the bone. And those bony particles that lie parallel to the length of the bone send out vessels from their sides that issue out through the side of the bone. It is impossible for those who have not seen this to conceive the prodigious number of small vessels whereof the cortical part of the bone consists; which in some places lies no thicker upon the spongy part than a thick hair of a man's head, tho' in other places it has three or four times that thickness. To the cortex of the bone the periosteum is united, not only on the outside, but even by entering in many places into the very substance of the bone, and is joined to it by the vessels which issue from the bone, in such a manner that sometimes one cannot determine which is the bone and which belongs to the membrane investing it, both appearing in the microscope to consist alike of exceeding small vessels. To make this better understood I have given in fig. 129. a representation of a small part of the bone with the periosteum adhering to it, in which A B C D E F represents the bony part, whether taken from an ox or sheep I do not now remember. The periosteum is marked with the letters B G H I E, the thickness of which is designed by B G, or I E, tho' in other places of the bone, and even at no greater distance than two or three hairs breadth, it is twice or thrice as thick. Here all the small vessels in the periosteum are represented by so many dots or points; but in other places where I have several times seen the membrane of twice this thickness the upper half of it appeared to be of a different make from the under part; for in the upper I could discover not only those vessels that had been cut transversely, and which consequently were represented by so many points, but likewise a great number of other vessels running lengthwise along the membrane, as in fig. 130. L O P Q N M. I am fully persuaded that the part represented by B G H I E,

Fig. 129.

Fig. 130.

HIE, fig. 129. is not entirely membranous, but that some part of it is really bony. If we cut thro' the periosteum so deep as to divide the part of the bone marked with the letters A B C D E F, in the same figure, we find the same appearance of pores in the bony substance, which are no other than the transverse sections of small vessels; and besides these there are other vessels running longways in the bone. And we find just the same in those transparent parts that lie between the bony particles, which are represented thicker between B C D E than they appeared to me. It is my opinion that the use of these bony particles is to convey an oleaginous liquor into the periosteum, and that from the periosteum it is carried by the intervention of the other membranes into all parts of the body when in a healthful condition. In another place I saw a great number of vessels arising from a greater depth within the bone, which drew closer together so as to compose small fasciculi before they entered the periosteum, in which they separated one from another and dispersed themselves again. It is difficult to determine whether these vessels bring any liquor into the bone or carry it out; but I rather think they serve to carry it out. Having placed another piece of bone before the microscope with the periosteum adhering to it, I could discover a great number of vessels that I had cut through lengthways as they ran along the periosteum, and others that were cut thro' transversly and appeared as so many points, as in fig. 130. K L O P Q N A, where the bony part is marked by the letters K L M N A, in which, tho' no pores or vessels are here represented, yet is it full of openings. That part which is design'd by L O P Q N M we must not take to be entirely membranous, for I am of opinion that that part of it which lies next the bone, and which is represented by L M N, is of a bony substance. I had another small piece of bone lying before a microscope, of which I caused a part to be represented by R S W X T V, fig. 131. in which R S T V is the Bone, and S W X T the periosteum, Fig. 131. which in this place was no thicker than a thick hair of a man's beard, but in another part of the same bone at a small distance it was full four times that thickness. I placed another piece of bone before a microscope, so that the bone did not appear, but only the periosteum and the muscular fibres, which were cut thro' transversly and appeared to be surrounded by the fibrillæ of the periosteum, as in fig. 132. where Y Z A B is the periosteum, and Z C D A the Fig. 132. fleshy fibres cut thro' transversly. This piece of bone was taken from one of the ribs of a fat ox. and I was surprized to find that in this place, as I cut longways thro' the ribs, I could not discover any particles of the marrow, whereas in other parts the rib abounded with them. I had kept some pieces of a fat ox's ribs full two months by me, so that they were now grown very dry. From one of these I cut off a very thin slice, and placed it before a microscope. It is represented by A B K C, fig. 133. having been cut off transversly Fig. 133.

and as thin as possible from the rib, with part of the periosteum, as from K to C, still adhering to the bone, and another part of it B K D torn off from the bone, except that in some places the bone and the membrane are still united by vessels torn out of their places that run from one to the other. In this figure D E F C represents the periosteum, and E G H I F is something lying upon it, which I could not tell what to make of, tho' it appeared to me to be membranous. From some very thin slices shaven off the rib both of an ox and of a calf I tore the periosteum entirely, or at least as much of it as possibly I could; the edge of the bone to which it stuck is represented by L M N, fig. 134. In fig. 135, O P Q represents the edge of another small slice of bone, from which the periosteum was torn off; by its appearance it should seem that the union of the periosteum with the bone is so firm and strong that, in separating it, some of the superficial particles of the bone are torn off with it. I have likewise discovered some vessels within the marrow-bone of the shank of an ox, that seemed to be blood-vessels.

Since it appears from our observations, which have been made with great diligence and care upon bones of all kinds, that they consist for the most part of exceeding small vessels, which arise from the inner, hollow, or spongy part of the bone, and passing through the superficial or cortical substance enter the periosteum, and are from thence continued even into the utmost parts of the body; we may from hence reasonably conclude that, in a healthful body, as there is a constant supply of an oily substance carried into the bones, so this is again constantly carried out from the bones by means of these vessels into all parts of the body, even to the extremities of the fingers.

*The scapula
and head of
the os humeri
falling off up-
on a mortifi-
cation. By
Mr. P. Derante
to Mr. J.
Douglas.
n. 370. p. 15.
Jan. &c. 1722.*

II. **N**OV. 5, 1713, one John Fletcher on board the Neptune of Liverpool, had the misfortune to break the radius and ulna of his left arm, the ends of which burst thro' the skin. He was immediately dressed by the surgeon of the ship with the common astringents and bandage, and about five or six days afterwards I was desired to visit him. I found his surgeon along with him, who told me he would do very well because he was in no pain at all; however uncovering his arm I found it black and insensible from his fingers to his shoulder, and therefore advised the immediate amputation of it, which his surgeon opposed; however I scarified it very deep in several places, and then applied a warm dressing. Next day the ship put to sea and the poor creature was sent to Waterford and committed to my care. As soon as I could get my apparatus ready, I cut off his arm as high as possible, and cauterized the stump, which was perfectly mortified as high as the acromion. Next day perceiving the mortification spreading toward the lower angle of the scapula, I rubbed the edges of the mortified part with armed probes dipt in a solution of argentum vivum in aq. fort. which compleatly answered my

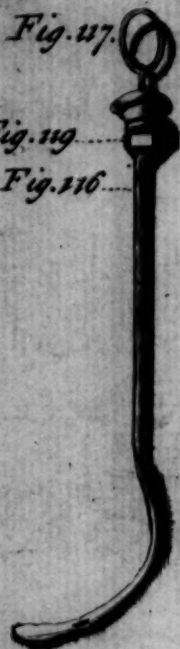


Fig. 119.

Fig. 116.

Fig. 118.

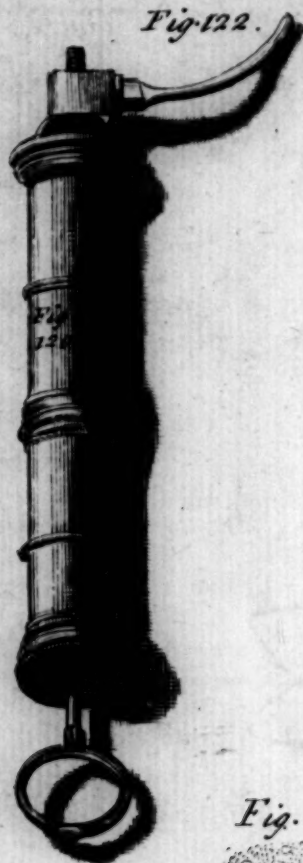
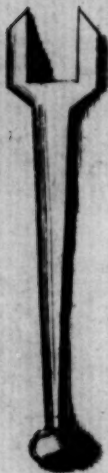


Fig. 121.



Fig. 126.



Fig. 127.



Fig. 130.

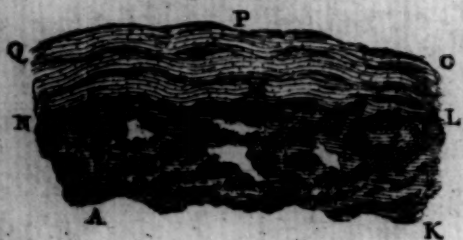


Fig. 131.



N

Fig. 123.



Fig. 124.



Fig. 125.



Fig. 128.



Fig. 129.



Fig. 132.

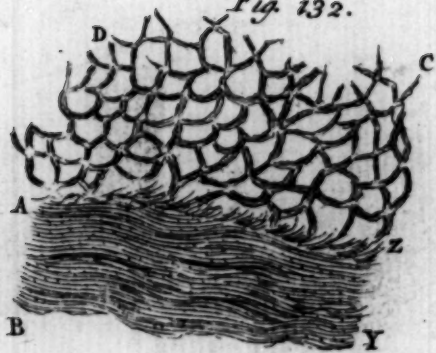


Fig. 133.



Fig. 134.



Fig. 135.

J. Mynde sculp

my intention; for from that time it spread no further; next dressing I scarified and cauterized all the mortified part, and dressed it f. a. I continued this method for seventeen or eighteen days, and then the sloughs began to separate and cast off daily; some time afterwards the scapula began to part from the os humeri and clavicula, and at length came out whole; I was then put to it what to do about the stump of the os humeri, which still adhered to the pectoralis and latissimus dorsi; but in a little time it also separated and came away, without any hæmorrhage succeeding as I expected. I was then obliged to cut off part of the clavicula before I could cicatrize the wound, which was soon afterwards accomplished.

III. **T**HE curious Mr. Ruysch, in an observation on the spina bifida, takes notice that other writers have described it to be cloven into two equal parts longitudinally, as butchers split the back-bone of an ox or sheep; whereas of ten subjects which he examined not one was so, the body of the vertebræ being entire and the acute processes only divided. Pretty near this description is the spine before us. The back-bone is of a female infant six days old; whose mother, when seven weeks gone with child, being frightened by her husband's falling from his horse and very much bruising his loins gave the embryo this injury; however she went out her time and the child was full grown. There appeared upon the region of the loins, in the same place where the father had received his hurt, a tumour about the bigness of a small turnip with a broad basis, around which the skin was discoloured as by an ecchymosis, but it grew immediately from thence pellucid, like a vesicle raised by cantharides, and continued so throughout, except just at its apex, where was a substance like a fungus. This bladder was filled with a liquor which in scent and colour resembled the true urine so much, that upon comparing the linnen stained by both we could perceive no sensible difference, and concluded there was a communication between the left kidney and the orifice, into which the surgeon's probe passed obliquely upwards about an inch. Whether the same similitude may hold betwixt the urine and this liquor in all cases of the like nature, I have not had opportunities to observe; but as Mr. Ruysch has taken no notice of it in such a number of subjects as have been before him I am apt to think it does not. Upon opening the body, the kidneys, contrary to expectation, were perfect, and did not any way communicate with the outward orifice. Having cleared away the fungous substance, which took up all the sulcus or hollow of the spine, a long probe easily passed through the perforation up the channel which contains the medulla spinalis. Throughout this fungus were dispersed a great many endings of small nerves, from whence distilled this, as it were, urinous liquor which occasioned the tumour: the rest of the medulla was more compact, and filled the cavity of the spine; tho' in some subjects it has been wasted to such a degree

A præternatural tumour on the loins of an infant, attended with a cloven spine. By Dr. Rutt. n. 366. p. 98. Sept. &c. 1720.

degree that by blowing into the orifice one might inflate the dura mater; as was done by Mr. Dobyns in a case of this nature. The coat of the tumour consisted at its basis of the cuticula, cutis, and membrana adiposa: the two first of which forthwith terminating, the cuticula only was continued; immediately under which appeared the muscles and fungus above-mentioned. In this it differs from those of Mr. Ruysch, which received their coats from the membranes that cover the medulla: as likewise from those taken notice of by Tulpus, which borrowed theirs from the peritoneum, as he says; tho' by his own description it is more likely they proceeded from the same membranes.

These tumours constantly attend the spina bifida: insomuch that when any of them present themselves on the loins or back of a newborn infant, we have good grounds to pronounce this to be the cause; but we may be positive in it if the child can't move its lower limbs; the want of which motion is an infallible indication that the medulla spinalis reaches no farther than the swelling, whereby the nerves are not distributed to those parts. They appear differently in different subjects. In some the whole tumour is opake; which proceeds from small filaments of nerves propagated in great numbers throughout its coat, and not from the thickness of the skin, as Ruysch will have it. In others it is pellucid; and then the medulla terminates at once at the aperture of the spine, and does not shoot out into any ramifications. This before us is a composite of both species, the greater part of which was pellucid; the less, viz. the apex, opake.

The back-bone itself is not cleft, but has its vertebræ with their other processes entire, and is only defective in its spines or acute ones. But that portion of the vertebræ which should make an acute angle, from whence their spinal processes naturally arise, in order to form the specus or passage for the marrow, instead of that gapes and lies almost in a strait line on each side; whereby the medulla is defrauded of its usual guard from external injuries. This defect begins at the third vertebra of the loins, and is continued to the end of the os sacrum: which last is very extraordinary, it scarcely ever happening to this bone; the reason of which I take to be the more than ordinary compactness of its vertebræ, whereby it is less liable to be injured by any impression. For we observe, that in adults they grow so close together as to unite and form one large and solid bone.

As the case before us is a vitium conformationis owing to the mother's imagination, so the same sometimes is occasioned by matter lodging upon the spine and eroding the vertebræ by its acrimony: but then you find a carious bone, whereas in these præternatural cases there remain no such footsteps. This was the case of the late Lord Peterborough, as related by Mr. Cowper, who upon opening the body found a large tumour from whence flowed a brownish coloured matter;

matter; and under it the upper and fore-part of the ninth, and the lower part of the eighth vertebræ of the thorax were consumed and gone, the medulla spinalis being covered with its membranes only. This gave rise to those symptoms in that morbid case, so nearly resembling the above-recited in this præternatural one.

It is manifest that these cases are incurable and must in a little time kill the patient. But it is almost immediate death to open the tumour; which every surgeon will naturally do that has not seen or read concerning it; the fluid seeming to require a discharge.

IV. **R**ichard Burt, near Bristol, by a fall from his horse received such a hurt in one of his knees as made him incapable of remounting: he felt somewhat crack in that knee, as he expressed it, before it touched the ground. Upon examining the part I found, as I then thought, the ends of the broken bone drawn above four fingers distance from each other: but upon a stricter examination of the parts, I found the patella (which was drawn upwards by the extensors of the leg) retained its natural figure, and that the hardness which was felt below was the end of the torn ligament that ties it to the tibia. The ends of the ligament were brought as near as possible, and kept so about three weeks without any very remarkable accident intervening. He then began to walk, which was a little too soon, causing thereby some pains and loosening the cicatrix, which made it the longer before it was perfectly firm; however he walks now without any perceptible lameness. I have met with two others in the same case, the one a person of distinction, who had not the good fortune to be so well cured, tho' not for want of all the care and circumspection imaginable; for it is hardly to be expected that one in ten to whom this accident happens should ever go right, it being next to an impossibility that the ends of the torn ligament should be so exactly placed and retained as not to lie one over the other.

*A case in chi-
rurgery com-
monly mistaken
for a fracture
of the patella.
n. 365. p. 44.
May & 1720.*

Pareë † affirms that he never saw one who had this bone broken that did not halt ever after: this I am very apt to believe, but must dissent from his notions of the case, and the cause of the lameness. Hildanus ‡ has given us a history of a transverse fracture of this bone, which, after all the symptoms were removed, was cured. “Sed claudicatio ac summa imbecillitas totius cruris secuta est, ita ut non nisi maxima cum difficultate ambulare posset.” As to the cause of the lameness he makes a query concerning Pareë's opinion of it †. “Etsi vero opinionem hancce rationi consentaneam esse in dubium revocare minimè conabor, unus tamen restat scrupulus, videlicet, an, fractâ patellâ, extuberantia calli talis esse possit ut cavitatem hancce (quæ inter femur & os tibiæ magna est) adeo adimpleat ut

† B. 15, ch. 22.

‡ Observ. chirurg. cent. 5. observ. 88. p. m. 485.

† Exc. lib. de ossibus, lib. 4. cap. 2.

“ motum actionemque genu impedire possit? Videmus enim ut plurimum in reliquis ossium fracturis (nisi contritio ossis & periostei fuerit maxima) naturam tam decenter & eleganter connectere ossa ut rarò relinquitur vestigium fracturæ. Periosteum enim, quam diu integrum est, materiam calli retinet quo minus in extuberantiam excrescere possit, nisi, &c. Deinde in hoc nostro ægro callum non fuisse causam claudicationis ex sequentibus apparebit: quapropter distinctione hic opus est.” After this he goes on to show us how many ways this bone may be fractured, but doth not observe that he ever saw it any other way broken, (unless in a gun-shot-wound) than transversely; if he had, I am persuaded this curious observator would never have omitted it.

Ruyfch † writes as follows: “ Patellam propter duritiem suam haud frangi posse nonnulli perverse asserunt. Nos vero eandem non solum à casu graviori in genu frangi experti sumus, verum etiam sine casu; cujus rei historiam recensere animus est. Ante tres præterpropter annos visitavi cum magistro Petro Adriani filio virum satis robustum, qui a ponte descendens in terram fere ceciderat; uno pede lubrico, resistens tamen quantum potuit in terram non fuerat prolapsus; sed ab illa resistentia vehementissima transversim fracta ejus patella, & adeo quidem evidenter ut inter utrumque locari potuerit manus, una enim supra, altera infra genu sentiebatur.” This observation is so like in all its circumstances to that which I related above, especially in that the fracture was made without a fall, that I am very apt to believe it is the same; and imagine he might be deceived by mistaking the hard end of the ligament for the broken bone. And when these sort of accidents which are now called fractures of the patella come to be nicely examined, they will perhaps be found to be generally of the same nature.

*Concerning
the different
height of a
human body in
the morning
and at night.
By the Rev.
Mr. Wasse to
Dr. Mead.
n. 383. p. 87.
May 1724.*

V. 1. **H**AVING observed several soldiers discharged for being a little under the standard, and having experienced the difference of a man's height in the morning and at night, I mentioned it to an officer, and thereby kept some persons from being turned out of the service. Since that time I have measured a great many sedentary people and day-labourers, of all ages and shapes, and find that difference to be near an inch. I tried myself sitting, and found it in like manner; particularly August 21, 1723. weather warm, no wind, at eleven in the morning I sat down, and fixed an iron pin so as barely to touch it. Then I fatigued myself for half an hour with a garden-roller, and at half an hour after twelve I could not reach the nail sitting by about half an inch. At two the same day I wanted near six tenths of an inch. On the 21st, at half an hour after six in the morning I touched the nail fully; and after the above-mentioned exercise for only a quarter of an hour, at about a quarter after seven, I fell short almost as much as before. On the 27th, having sat up late with some

† Cent. observat. anat. chirurg. observ. 3.

friends, I was faint and felt my self heavy and without any spring, and at 9 in the morning I did not reach the nail, though I had us'd no exercise. I rid out, but could not reach it that day. On the 28th I rid about four miles; and whereas at 6 that morning I reached the nail, I had lost 6 tenths of an inch by 8. Sept. 19th I came from Oxford a little tired, and next morning at 8 I wanted half an inch. If I study closely, though I never stir from my writing-desk, yet in 5 or six hours I lose near an inch. All the difference I find between labourers and sedentary people is, that the former are longer in losing their morning height, and sink rather less in the whole than the latter. I cannot perceive that when the height is lost it can be regained by any rest that day, or by the use of the cold bath. I have not informed my self so well about horses; my mare comes seven this grass, is strong, short back'd, and well legg'd. I measured her before and after riding 20 miles April 30th, and could not perceive the least difference in her height. The alteration in the human stature, I imagine, proceeds from the yielding of the cartilages between the vertebræ to the weight of the body in an erect posture.

V. 2. **I** Have farther observed that in young persons the alteration is more considerable than in those that are aged. The trials succeeding equally in a sitting and a standing posture will naturally lead us to think that this remarkable alteration must necessarily arise from the trunk of the body. Now a person's stature has been always thought to be determined by the whole compages of the bones. But there is something very wonderful in the structure of the spine. The thickness and shortness of its bones, with the intervening cartilages, assisted by the bony processes, dispose it to a motion peculiar to it self. Whereas had the bones been of any considerable length, upon bending the body the articulations must have made a large angle upon their inmost edges, and the spinal marrow have been continually liable to be injured; or had the cartilages been entirely wanting, it would have been as useless as if it were but one bone, and we rendered incapable of bending the trunk of the body. But by the present disposition of its parts 'tis not only secured against any such inconveniences, but, although so small a pillar, is capable of supporting without hazard, prodigious weights. The different thickness of the cartilages placed betwixt the bones of the spine is also very remarkable; the vertebræ of the breast requiring little motion the cartilages are there but thin in comparison of those of the loins, where the motion is vastly greater: and as the cartilages are abundantly thicker before than behind, we bend our bodies so much more forward than backward; and by this means also in all violent exercises the parts contained in the belly and breast are in a great measure secured from any damages they might have been liable to, because by the pliability and elasticity of these cartilages they break the violent shocks which the viscera must otherwise have necessarily sustained. From

*Remarks upon
the preceding
observation.
By Mr. W.
Beckett.
Ibid. p. 89.*

what

what I have remarked concerning these peculiar properties of the cartilages we may suppose them to be compressible, dilatable, elastic bodies, which will yield to any incumbent weight that is sufficient to force their particles closer together, and that when this compressive power is removed they will of themselves recover their former state. Every inferior cartilage of the loins is thicker than the superior, and consequently more capable of having its thickness diminished by any pressure; now all superior bodies pressing upon the inferior, the whole weight of the body, except the lower limbs, must be sustained by the lowest vertebræ and their cartilages; but these cartilages being much thicker than the rest, and the incumbent weight bearing harder upon them, they must be more compressed; and consequently, when this weight is removed, their expansion by their natural elasticity will be greater also. This being the state and disposition of these parts, while we are employed about business till we dispose our selves to rest, the cartilages of the spine will by their compressible and yielding properties, become more close and compact from the perpendicular pressure they sustain, and the spine, the only support of the trunk of the body, will become shorter. But when this superior weight shall be entirely removed by placing the body in a horizontal posture, as it always is when we are in bed, the compressed cartilages will, by their elastic power, gradually recover their former expanded state; and so will produce a considerable alteration in a person's stature. I have only one particular farther to observe upon this head, which is, that this alteration cannot be the same in aged persons as in those that are younger, because the cartilages, as we advance in years, gradually grow harder, till many of them arrive to the solidity of a bone; that is, by degrees they lose their spring or expansive power, and at length continue in a compress'd state of rest. And this is without doubt one principal cause, why old people not only seem to have lost somewhat of their former height, but are actually shorter.

C H A P. VII.

PHARMACY *and* CHYMISTRY.

*Concerning
the operation
of medicines.
By Dr. John
Quincy, to
Mr. Moreland.
n. 365. p. 71.
May &c.
1720.*

I. **W**ith regard to the operation of medicines I suppose 1. That all those parts of an animal body through which any fluid passeth, from the intestines to the minutest fibre, are the seat of medicine's operation. 2. That this whole course of circulation is, by the different capacities of the vessels and motions of their contents, naturally distinguished into three different stages, each having its proper

per out-let, and that these are the seat of the three concoctions so often mentioned by physical writers; the first in the stomach and bowels, having the anus for its emunctory; the second, all within the blood's motion, so far as it retains its colour, having the kidneys; and the third, all beyond that circuit, having the skin for an excretory organ.

3. That every medicine that causeth evacuation is a purge. 4. That every purge operates as a dissolvent, by fusing the juices and increasing the quantity fit for expulsion; or as a stimulus, by accelerating their motions so as to bring the matter fit for expulsion oftener to the secretory out-let; or both. These assumptions, which I expect, will not be disputed, are premised only for the better proof of this proposition: That a change in the bulks, figures, and motions of the component particles of a purging medicine, will change the seat of its operation, and fit it for acting in larger or lesser vessels as those mechanical affections are intended or remitted.

To illustrate this, it may be convenient to attend the management of common practice, in making a purge operate more or less than it otherwise would do. Substances which are gross and heavy, consisting chiefly of saline and earthly particles, as tartar, manna and the like, if reduced smaller by triture or repeated solutions, operate gently; but if acuated by acids or any management which exposeth their angles more sensibly to the membranes, they are rougher and act sooner. Resinous medicines, as scammony, gamboge, jallap, and most of vegetable production are more violent and operate sooner when they are more tenacious and adhesive, as in their extracts, but gentler when divided by hard brittle substances, such as salt of tartar, sugar, &c. Medicines which have their composition sulphur and salt are more or less rough and speedy in their operation, in proportion to their greater or lesser participation of the saline ingredient and the asperity of its angles: of this kind are most minerals and their preparations; it may be sufficient to instance in the management of antimony and mercury. The first of these is by chymical analysis known to be a composition of a subtil sulphur and salt, and the more the saline part is let loose by preparation and opening the sulphur, as it is term'd, with the more vehemence will it operate and the sooner; whereas in its lesser preparations when the salts are closely wrap'd up in their native sulphur they will hardly work at all till they are got into the farthest stages of circulation. Mercury per se is little known as a medicine, and its first preparation which makes it sublimate so loads it with saline spicula that it amounts even to a poyson; but the more those spicula are broke by triture, sublimation, &c. the milder doth it operate, and if to the comminution of its points be added a sulphur subtil enough to join it, it may be render'd so mild as not to be felt but in the last stage of operation.

This short view may be sufficient to shew, that it is excess of asperity and motion in a medicine that will not suffer it to pass the

stomach without irritating it into such convulsions as will throw it up again by vomit; that a farther comminution and smoothing its figure will admit it into the bowels and make it operate by stool; that a yet farther remission of its properties will carry it into the blood and allow it there to promote evacuation by urine; and that a yet farther comminution will pass it into the minuteft canals, where by the same properties in a lower degree it will increase perspiration or cause sweat: so that the subtiler medicines operate in the capillaries and smallest fibres by the same mechanism that more gross do in the common stream of the blood when they go off by urine, or the grossest of all in the greater passages when they promote stool. Hence the skill of preparing and administering of medicine consists in proportioning its manifest and known properties to the capacity and circumstances of the part it is to operate in, and to intend or remit its mechanical affections, as it is sooner or later to take place in the greater or lesser vessels.

Of the first class there are few to be reduced small enough to go beyond the greater passages, and none of them are worth the pains they require to fit them farther than for diuretics: besides, their natural fitness to attract and join with the serous part of the blood, whenever they get into that stage of motion, runs them off by the kidneys before they can undergo comminution enough to get farther; but if by frequent repetitions of such medicines and uncommon laxity of the passages, any thing is passed into the habit, their grossness fouls the delicate strainers which are left for their expulsion, and they lodge upon the glands and capillaries so as to induce intermittents; which is observable in many persons after the use of cream of tartar, the common cathartic salts, and the purging waters, especially at the latter end of the summer, when the heat of the preceding season hath debilitated the solids and left them under too great relaxation.

Among the resinous purges there are many very powerful ones, but where their operation is desired in the viscera, blood and remoter parts they must be extremely divided; and this we find spirituous menstruums will do, by taking up the most subtil parts only, and carrying them into very small passages, where their operation is chiefly by fusion, because the softness of such substances cannot enable them in hardly any degree to act as stimuli, farther at least than ordinary detergents. And thus we find aloes, the chief of this tribe, to go farther into the habit, and be longer e'er it operates, when managed in a spirituous menstruum, as in the *tinctura sacra*, the *rad. turpethi*; and colocynth likewise, with all of the vegetable kind that will yield to a spirituous liquor are to be carried by that means into the farthest scenes of animal action, and there prove efficacious medicines in cases that, with other management, they would never be able to reach: And on this foot it undoubtedly must have been that in practical writers

writers we frequently meet with many of this sort mentioned as alterants; the colocynth particularly by Helmont; for all medicines which operated in the farthest passages they commonly included under that general appellation.

But the most efficacious purges and those which require the most skill are from the mineral kingdom; these abound in solidity beyond any other materials, and therefore wheresoever they are brought into action excel in quantity of impulse: many of these therefore want not only the utmost comminution to carry them into the farther scenes of operation, but also some restraint of their asperities and motions, to fit them for many intentions. Thus sublimate is not only to be much sweeten'd, that is, smooth'd in its points, to make it a safe purge in the larger vessels; but if it is intended to go farther than the blood and those glands which in that circuit they are most apt to be lodged upon when it salivates, it must be rendred not only very fine but covered with such substances as weaken its points and make it strain into the last subdivisions of the constitution. To this purpose the common practice wisely contrives in distempers which lie farthest off, according to the course of circulation, to wrap up the basis of this medicine in sulphurs and such substances as follow it into its last division, without giving any asperities to make it act as a stimulus. Thus for all cutaneous foulnesses and habitual taints the cinnabar, the æthiops, and all of that sortment are in readiness; and that ordinary sulphurs will cover and deaden the efficacies of mercurial preparations, so that they shall not operate but in such parts only and in certain circumstances, is demonstrable in ordinary salivations, which are to be lower'd at pleasure by sulphureous medicines. Medicines from such minerals where a salt and sulphur are united by nature as they are in some mercurials by art, such as antimony, native cinnabar, steel, &c. are manageable only upon the same principles, and the more they are designed to be carried into the habit, the more they are to be restrained by their natural or adventitious sulphurs: steel when opened by, and joined with, the points of acid liquors operates sooner and will sometimes prove even emetic; but when it is covered with an additional sulphur it will go farther and answer intentions much more remote, as is manifest in the common preparations of steel with tartar or vinegar, and with sulphur.

This way of thinking on these occasions seems to me also the more just, from considering the texture of those substances which by a natural preparation are fitted for operating in the minutest part of an animal body, such as those of the aromatic kind, all which more or less, according to their greater, or lesser degree of subtilty and smoothness, promote a diaphoresis: They consist of exquisitely fine salts covered with a most subtil sulphur, as is demonstrable by chymical analysis; and the common sal volatile oleosum is an admirable contrivance upon the same foundation, where a very volatile animal salt is

covered with a most exalted vegetable oil, whereby it is suited to pass into the minutest fibres and make as it were a part of the animal spirits themselves. And here it may not be amiss to observe that all animal salts are very volatile, or easily rendered so, but when bare and naked, just as the fire draws them out, with a mixture also of its own particles, they are too pungent to be felt without painful sensations, but when softened with a fine portion of an opposite texture, which is smooth and yielding, they become most efficacious and safe sudorifics. On these considerations it likewise ceaseth to be a wonder why the subtil salts of cantharides are more sensibly injurious to the bladder than any other parts, and why camphire prevents those injuries; for the exquisite smallness of those spicula makes them imperceptible but in the most minute canals, into which the fibres composing the membranes of the bladder are known to be divided; and camphire blunts their irritations, because its exquisite subtilty enables it to follow them into those meanders and sheath their asperities. To this purpose it is very remarkable what many (as I have been informed) now commonly practise in guarding even mercurials against their stimulating properties, and sending them into the finest passages to operate by fusion and the bare force of impulse: for not only calomel and the mercurius dulcis may be restrained from manifest operation in the wider passages and the glands about the mouth, but even the mineral turbith, which of its self in a small dose will operate powerfully by vomit and stool, when mixed with camphire will not be so much felt in those respects, but go into the farthest circuit of motion, and promote the cutaneous discharge in a more efficacious manner than any medicine of less specific gravity. But in this management the camphire is to be mixed but very little before taking, otherwise it hath not this effect; probably on account of its great volatility which makes it in a great measure exhale while it stands mixed in a medicine.

This theory is applicable to many good purposes in practice, but because the limits I have set my self here will not suffer me to enlarge, I shall content my self with this only instance of camphire, which is enough to suggest in what cases that and other substances of like subtilty and texture may be used with success: for the seat and causes of many chronic distempers lie most remote in the course of circulation, and their eluding the ordinary means of cure, it is to be feared, is owing to the want of sufficient attention to that particular management of efficacious remedies which is necessary to carry their operations so far. An ordinary judgment knows how to intend or remit the efficacy of medicines by acuating their points and quantity of impulse, or softning and weakning them with broths and the gross-express'd oils of almonds or linseeds in the first and larger passages; but an active medicine or a distempered irritating salt in the minutest capillaries and fibres is not to be managed by such coarse instruments.

II.1. **U**SUS frigida & frigidorum in febribus haud recens est, sed *Of the use of cold water in fevers. By Dr. Nic. Cyrellus. n. 410. p. 142. July &c. 1729.* apud antiquissimos medicos minimè infrequens fuit. In febribus enim calidioribus, post paroxysmi ἀμυν, liberaliorem aquam vel cujuspiam refrigerantis liquoris potationem concedebant, quā defervescente febrili aestu aeger placidè conquiescens in criticum saepe numero sudorem exsolveretur. Verum febres curare solā nivatā aquā copiosissimè per plures dies exhibitā, omni subtracto medicamento alimentoque, id quidem omninò novum existimo; atque non solum insolenter, sed, ut verum fatear, audacter nimis non multis ab hinc annis hic tentatum, methodo, ut rumor fuit, ab Hispaniā rudi & indigesto commentariolo communicatā: quā curandi ratione nonnullos ex ipsis orci faucibus præter omnem expectationem ereptos sub oculis nostris attoniti vidimus. Hæere primùm cauti medici tantā aquæ alluvie perterriti: at frequenti felicissimoque eventu excitati tentabundi primùm mox audaciores facti, quod quidam cæco impetu & nullo morbi morbi que temporum discrimine aggrediebantur, ad cautiorem methodum rede gere: ita ut nullus jam apud nos sit medicus qui Cleophantus δειψυγε (ut notat Harduinus in Plin. lib. 26.) appellari nolit. Hujus methodi canones repetitis experimentis confirmatos exponam. Magnum enim remedium est diæta aquea, (hoc nomine appellare libuit) quare in illius administratione, quemadmodum in omnium magnorum remedium usu, accuratissimis cautionibus procedendum, ne quod pro ægotantis salute instituitur illius potius necem moliat. *μετὸν πρὸς τὴν ἐνδὴν ἐκκρίσιν ἐκτετακτὴν ἀποκρίσιν*

Præcipuus canon est ut post aliquot horarum à cibo absterentiam, ventriculo scilicet omninò vacuo, aqua nive refrigerata ebibi incipiat ad libram unam vel duas, pro ægotantis ætate, viribus, aut etiam siti. Eadem copia singulis horis aut secundā quaque, aut tardius repetenda, eademque noctu diuque, nullā factā intermissione nisi per subrepentem fortassè somnum, exhibeatur. A cibo omninò absterere debent ægotantes: experienciā enim constitit illum cum aquā copiosā permistum non solum ventriculo putredinem concipere, verum etiam ab eodem epotæ aquæ substantiam infici, eamque minùs aptam reddi quæ facillè exilissima vascula permeare adeoque in extima simul & intima corporis diffundi possit, ad præcipitationem & secretionem noxi-
orum humorum moliendam. Inedia hæc ad plures dies producenda, quousque scilicet febris vel prorsus intermiserit vel ad summam remissionem devenerit, atque aeger identidem de fame conqueri incipiat: si enim maturiùs exhibeatur cibus statim febris suis stipata symptomatibus iterum recrudescet. Quapropter nonnunquam ad septem, imò ad decem & plures dies (dummodò ab aquā non abstineatur) ægotantes ab omni alimento prohibemus. Neque ab hac absterentiā quidquam metuendum: vel quòd ob aquæ frigiditatem arctioribus redditis cutis spiraculis transpiratio insensibilis adeoque nutritionis necessitas imminuatur; vel quòd aqua ipsa nutrimenti officinas assiduò præterfluens, si quæ inibi sunt alimentorum reliquæ (sunt autem semper)

impactæ

impactæ eas secum rapiat, atque per universum corpus diffundens nutritionis negotio, quoad fieri potest, consulat. Quomodocumque autem se res habeat, illud quotidianâ praxi confirmatum est cibum cum copiosâ aquâ commisceri, absque summo ægri periculo, non posse: ita ut quamprimum cibus ægrotanti conceditur, sit vel absque potu vel cum exiguâ aquæ potatione exhibendus: imò concedendum quoque est aliquot horarum intervallum à frigidæ potu vacuum quo commodè cibus in ventriculo digeri queat.

Hic seligendus tenuissimus & ἀραιός, ut panis purâ aquâ coctus, pastilli de micâ panis, ovum forbile, vel ferculum aliquod jurulentum. Hæc semel primum & paucissima, hinc bis in die exhibenda, ut sensim ad lautiusculum prandium, servatâ tamen exiguâ cœnâ, gradum faciamus: omninò verò, etiam per mensem & ultrâ, carnibus parcendum. Cum hujus generis cibo vescuntur ægri haud aquæ valedicendum, sed peractâ illius assumpti digestionem, ad duas vel tres potationes erunt cogendi: quousque integrè devicto morbo corporis vires sensim recuperantes ad exoptatam convalescentiam perducantur.

In hujus autem curationis curriculo quædam accuratè animadvertenda sunt. Principem locum tenet observatio, num aqua assumpta facilem sibi transitum paret, an non. Cum urinæ, saltem post diei intervallum, copiosiores & decolores sensim fieri incipiunt, tunc aquam viam sibi facere coepisse puta. Nonnunquam primâ statim die vel secundâ tertiâve alvus solvitur, cum ejectione primum sculentioris saburræ, mox variegatorum humorum: hinc spes major affulget; febris enim, alvo solutâ, sensim se remitti atque symptomata sedari incipiunt. Quod adeò verum est, ut si secundus vel tertius dies excurrat absque eo quod ventre secedant ægri, etiamsi universa fortè aquæ quantitas per urinæ vias foras amandetur; clysteribus tamen suppositis & oleo amygdalarum dulcium per os assumpto lubrici reddendi: crassiores enim humores qui in primis viis continentur, quique febrem sovent vel in febricitantium corporibus ex morbo produci solent, haud possunt per cæca urinæ secernicula foras protrudi, sed per amplos intestinorum tubos sunt eliminandi. Adde quòd exantlatis primis ductibus facilè poterit aqua in ultimos corporis recessus trajici, atque sanguini aliisque secundariis ductis liquoribus medicinam facere.

Si verò accidat (accidit autem sæpè) ut parotides appareant, vel cum ipsis alvi vel urinæ excrementis purulentum quid intermistum observetur, quod evidens indicium est maturi & rupti jam abscessus; haud ab aquæ exhibitione surperfedendum sed eadem urgendum magis est. Una enim aqua quæ stagnantes in internis partibus humores ad externas depellere, collectos ad maturationem perducere potuit, vim quoque habebit eisdem per varia corporis secernicula integrè deturbandi, atque partes abscessu prehasas à necrosi præservandi: quemadmodum sæpissimè in praxi vidimus. Praxis tamen eadem nos docuit abscessus in cerebro & thorace factos non adeò facilè aquæ usu superatos

superatos esse: etsi non paucos vidimus pure è naribus, auribus, ore, & tussi quoque è pulmonibus educto integrè sanatos. Solemus proinde cùm talium symptomatum signa superveniunt haud aquæ præsidium respuere: sed si somnolenti evadant ægri, vesicantia vel aliud phænigmatum genus applicare: aut si difficultate spirandi exerceantur, oleum ex amygdalis dulcibus recens expressum propinare, vel aquam ipsam ex frigidâ tepidiusculam reddere. Non rarò insuper accidit ut primis præsertim aqueæ diætæ diebus vomitus, & quidem vehemens, superveniat: quo si heterogenei humores, ut fieri solet, ejiciantur pro bono habendum; cessat enim cum ægrotantis levamine postquàm ventriculus omninò exoneratus est. Quòd si aqua ipsa vix epota evomatur, ad iteratas & frequentiores potationes æger cogendus: etenim aquam vomitu rejectam maligni humores subsequi solent. Constanter item & assiduò aqua est exhibenda si singultus suboritur: hunc enim quemadmodùm ab aquâ excitatum ita ab aquâ continenter epotâ compesci observamus. Sudor verò si frigidam potanti superveniat solet vires exsolvere non sine magno vitæ discrimine: id quidem paradoxon videri poterit iis qui ex frigidæ in febribus potu sudorem expectant, in quo magnum domini Hancock febrifugum consistere scimus. At in diætæ aqueæ usu si sudor superveniat is cohibendus, aquâ adhuc frigidiori & copiosiori exhibitâ, ægrique corpus remotis stragulis, ventilabro & perflatu conclavis refrigerandum: sunt qui & nive ipsâ contritâ conspergere audent.

Maxima porrò in aquæ usu medicorum crux est cùm ægri vel delirio, vel lethargo, vel summâ virium abjectione affecti ad aquam justâ copiâ & frequentâ bibendam impares redduntur. Tunc quidem omnis adhibenda est industria ut postremum quod illis restat remedium, nempe aqua, exhibeatur: quod à delirantibus vi & minis, à valdè debilibus & consopitis nive in os intrusâ, per fas & nefas, nonnunquam extorsimus.

Post expositam aqueæ diætæ methodum, & quomodò symptomatibus *ἐπιφαινόμενοι* occurrendum sit, reliquum est ut quibus in febribus, & quo illarum tempore ad hoc præsidium deveniendum sit, exponamus. In principio sanè universali febrium haud opportunum est statim aquam arripere: quum enim tunc temporis cruda & crassa sint omnia, haud jure speres à copiosâ aquâ peccantes humores posse vel secerni vel exturbari. Secùs in morbi statu cùm omnia exacerbata sunt & *ἡ νόσος αὐξάνει*, ut ait Hippocrates, cùm nempe æger ad maximum periculum perductus est: aquæ præsidium opportunum locum habet: tunc enim materia febrim fovens ex diutinâ ebullitione particularum contritionem quandam, vel si mavis aliqualem coctionis umbram adepta poterit copiosæ aquæ exhibitione, illiusque cum humoribus corporis permissione veluti præcipitari, secerni, atque quâ data porta evacuari. Hinc igitur sæpe accidisse vidimus, ut fortunatiùs evaserint qui in ipso veluti mortis agone constituti ad hoc extremum præsidium tanquam ad sacram anchoram confugere. Hoc monitum

negligentes

negligentes audaculi quidam medici aquam in febrium principio vel incremento exhibentes in maxima pericula, & mortem ipsam, ægros deduxere. Non inficias tamen iverim in febribus biliosis, seu tenues humores pro causâ agnoscentibus, non infelici ausu aquam quandoque in ipso principio exhibitam esse: & ratio ex suprâ dictis evidentissima est.

In febribus igitur acutis, malignis, & lethalibus omnis generis, quo tempore opportunum videbitur, quod à maximo ægri periculo significari solet, ad diætam aqueam deveniendum. Nam vel febres tales sunt ex quibus ad concretionem tendit sanguis; & tunc aquâ copiosâ cum eo permistâ faciliè poterit fluidam naturam ferè amissam iterum recuperare; vel ex febre sanguinis massa ad nimiam tenuitatem cum spirituum exsolutione vergit; atque hoc casu aqua, præsertim frigida, salia acria sanguinem dissolventia solvere & retundere potis erit. Unde phænomeno lux, cur scilicet frigidum jam redditum febricitantis corpus ex frigida potatione veluti miraculo incalescat. Sive enim sanguis ex pernicioso spirituum effluxu concreescere incipiat, sive ex nimia illius dissolutione spiritus evolent; semper frigida copia cum illo permista (accedente quoque pororum cutis constrictione) æque spirituum dissipationem prohibebit, adeoque calor amissus revocabitur.

Hinc illud hic inculcandum quod à principio insinuavimus, aquam non nisi nivatam febricitantibus præscribendam: primùm enim frigida se eâ copiâ ingurgitant ægri quæ operi necessaria est, calidam verò respuere post primas potationes solent: præterea ab aquæ frigiditate ventriculi fibræ vis major elastica accedit, quâ propelli in ultiores vias usque ad sanguinem ea faciliè possit; contra tepescens fibræ easdem ad atoniam disponens sui mole ventriculum inflat, pondere premit ac anxium reddit.

Haud tamen dissimulabimus nos quandoque non frigidam, sed calentem aquam præscribere: cum scilicet pulmonum & viscerum inflammationes & dolores cum febribus copulantur: veriti ne frigidum partes phlogosi prehensas ad *νεκρωσιν* disponat. Verùm negare minimè possumus in his casibus nonnunquam ad frigidiusculam, etsi non nivatam, transitum fieri: cum nempe tepentis aquæ fastidio affecti ægrotantes illam assiduò bibere renuunt. Satiùs enim esse reputamus multam frigidiusculam, quàm paucam tepentem sed operi imparem ministrare.

Juxtà hos canones (quos experimenta sæpiùs instituta, & ratio postmodùm si non invicta saltem non omninò infirma suasit) diætâ aqueâ in febribus multoties usi felices eventus notavimus, ut *ἀγασθὲν μὲν ὕδωρ* verè fateremur. Nonnunquam tamen præconceptâ spe frustrati sumus, quod à medicinæ fortunâ, præsertim in magnorum medicamentorum administratione, non abhorret: nil enim adeò certum in illâ est quod fallere etiam accuratissimos practicos sæpè non possit.

Hucusque de frigida usu in febribus locuti sumus: verumtamen sunt & alii morbi in quibus aqueam diætâ, & non sine ægrorum emolumento,

emolumento, analogifimo quodam ducti tentavimus. Tales sunt diarrhoea, dysenteria, imò & coeliaca, & lienterica affectio: tales sunt ischuria renalis & dysuria: tales cardialgia & cholera morbus, hypochondriaca & hysterica affectio: nec caremus exemplis hydropis (quis credat?) copiosâ aquâ epotâ curati: referatis nempe cœcis renum & alvi viis è quibus & aqua & serofus latex ubertim effluxit. Imò & salutarem aqueæ diætæ usum experti sumus in variolis, sed in tertio illarum stadio ad necem ægris tendentibus ex abscessibus in cerebro & pectore formatis: quo remedio ingentem puris copiam è naribus & ore excerni vidimus. Haud tamen in omnibus his morbis aqueam diætam, hoc est, aquam solam omni interdicto cibo adhibemus; sed in chronicis largâ frigidæ potatione quatuor horis ante parcum prandium, atque alterâ octo horis à prandio, contenti esse solemus.

Hæc quidem sufficere putavi ad meum propositum: unum tamen postremò animadvertendum apprimè esse duco quoad aqueæ frigidæ exhibendæ copiam; gravius scilicet delinqui si minori quantitate propinetur quàm si excedenti. Quum enim eo fine febricitantibus in valde ancipiti statu constitutis aqua exhibeatur ut in totum corpus diffusa meatus referet, liquoribus motum & tenuitatem naturalem impertiatur, ac membrorum omnium calorem roburque foveat; id præstituros nos frustrâ pollicebimur modicam propinantes aqueæ quantitatem, quæ in ventriculo & primis visceribus moram trahens tantum abest ut possit ulteriùs progredi, ut potiùs cum noxiis humoribus ibi stagnantibus permista illorum putrefactionem promoveat ægroque perniciem molitur. Opus igitur est ut maximâ quantitate & successivè ingeratur, ad hoc ut copiâ viam sibi paret & veluti alluvie corpus universum inundet. Id autem eò audentiùs prosequendum, si post primam transactam diem transitûs aqueæ signa per urinam vel alvum apparuerint. Eò enim aquam reliquis remediis securitate præstare putamus quòd tametsi nonnulla medicamenta possent fortassè maximos morbos debellare si excedenti dosi exhiberentur, veluti stibium diaphoreticum, bezoarticum, & sal volatile quodcumque, & ipsum vinum generosum copiosè epotum; verum tamen quis non videt ex ipsâ excedenti dosi maximum vitæ periculum, debilibus præsertim ægrotantibus, imminere? sola aqua innocentissima & tutissima videtur: vix enim æger est adeò viribus destitutus qui uberriam aqueæ copiam sustinere non valeat. Hinc haud *παρὰ μέτρον* factum puto, si etiam cùm desperata res est & jam conclamatum medicus factò prognostico, & expositâ quidlibet audendi occasione, aqueam diætam, etsi contraindicatum remedium, si non præcipiat saltem permittat: nonnunquam enim improvisis naturæ modis desperatos jam ægros ex insperato ad salutem rediisse vidimus: ut pro sano consilio illud habendum sit satius esse anceps remedium experiri quàm nullum.

Hæc sunt quæ apud nostrates de aqueæ in morbis usu experiri usu venit, quo nullum familiarius per vulgi ora nunc fertur ægritudinum

omnium remedium : ut nostris his temporibus aptari commodè possit verficulus quem de Euripide à ventris cruciatibus ope clysteris maris aquâ parati liberato refert Laërtius :

Ἡ θάλασσα κλύσει πάντα τῶν ἀνθρώπων κακὰ.

An simile accidere possit in frigidioribus regionibus (de quo haud desperem, nam etiam hybernâ tempestate tales per frigidam curationes hîc feliciter prosequimur) videant accuratissimi viri qui in boreis terræ plagis non sine maximâ laude & fortunâ faciunt medicinam.

Excessive vomiting of blood cured by drinking extremely cold liquors in winter. By P. Ant. Michelotti. n. 419. p. 129. June Sc. 1731.

II. 2. QUUM juvenis præstantissimus Ludovicus Maffetti rure, ubi venatione & perequitando se vehementer exercuerat, in urbem reversus sanguinem decimo calendas Jan. CIO CCC XXVIII. ad uncias quinque sexve matutinis temporibus vomeret, hujuscemodi curationem institui. Primum, quod cruoris in arterias venasque vim eas distendere continenter nitentem insigniter, & præcipuè ex superfluente sanguineæ materiæ copia adauctam animadverterem; minimèque ignorarem juvenem laborare scyrrhoso lienis tumore, ob quem, & sanguinem vel hos ante quatuor annos evomuerat, & narium copiosis hæmorrhagiis à prima usque adolescentia vere & autumnò quotannis tentari consueverat; quæ, posteaquam fortuito à lusoribus follis capiti impactus fuerat, ferè ex toto defecerant; quod hæc, inquam, minimè ignorarem, ad uncias circiter octo ex hæmorrhoidibus sanguinem per hirudines protinus mitti, ejus copię demendæ atque à liene & ventriculo avertendæ causâ præcepi; tum aquam ex plantaginis succo corallato nitro bene saturam cyathi mensura sæpius eo die sorbendam præbui ad sanguinis fervorem compescendum. Sanguineo verò vomitu circa secundam noctis vigiliam vehementiùs urgente, & sanguine maximo impetu copiosissimè ad os ruente, aquam ex lactucæ succo ad unciarum quatuor pondo, cydoniati J. B. Helmontii laudani guttis duodecim commistam confestim potui dedi, & cruoris potissimum velocitatis minuendæ & somni accersendi ergò: quod medicamentum quum æger, sanguine ex ventriculo tertium quartumque ingenti copia erumpente, rejiceret, ad catapotia ex perfici philonii scrupulis sex, ex aqua succi sanguinalis herbæ devoranda decurri. Sub idem tempus gelidam aquam frigido aceto permistam ore contineri, spongiam perfrigido aceto benè imbutam epigastricæ regioni admoveri jussi, ad sanguifera stomachi vasa, sive exesa sive rupta sive quocunque modo patefacta, constringenda: quem in finem, quandoquidem idem cruentus vomitus quintum sextumque revertebatur atque æger exanimari videbatur, non modò ad confectionem ex contusis albi papaveris & hyosciami seminibus, rosaceo saccharo, armenia bolo, ac lapide hæmatite adjectis, semicochlearii pondere devorandam decurrebam; sed ad consolidantia quoque catapotia, quæ sub autore Helvetio patre feruntur, quorum terni scrupuli quarta quaque hora assumentur ex aqua modò commemorata, in qua modica pollinis ex margaritis & rubris coralliis in calcem redactis, itemque

itemque ex magisterio (ut chymici loquuntur) oculorum cancerorum portio soluta erat. Per hæc auxilia consecutus sum ut sanguis per aliquot horas conquieverit.

A sanguinis per sectas venas detractione ea nocte abstinui; primùm, quòd sanguinem ad libras duodecim & amplius duarum circiter horarum spatio ex ore processisse, jacentemque ob id in conclavi frigido, paucis vestimentis corpori injectis, animo linqui perspiccerem; tùm, quòd cordis & arteriarum coagitatio, & quod consequebatur, residui cruoris paucissimi velocitas esset quam maxima; indè, quòd ad avertendum tantæ sanguineæ materiæ à ventriculo cursum exiguam sanguinis emissionem & parvo quidem tempore duraturam, sive ex parte ab ipso affecto ventriculo minus remota sive ex vena quàm longissimè ab eo distante, haud sufficere existimarem; postea, quòd vel per medicam, hujusemodi rebus circumstantibus, sanguinis detractionem sulphuratarum sanguineæ massæ particularum ad coccineas massulas penè ex toto deficientes proportionem jam notabiliter (uti ex magna siti, corporis calore, brachiorum, & crurum jactatione, insignique pulsus frequentia conjiciebam) incrementem, una cum sanguinis velocitate cruentum vomitum rursus excitare valente, summo-perè adaugeri posse providerem.

Albente cœlo vomitu denuò reverso ad sanguinem, qui notabilium quoque copia evomebatur, suppressendum frigidum ex urenti urtica succum, cui tosti opii grana octo admista erant, ad uncias quatuor potandum obtuli; qui quum ex toto non responderet ad extremum ratiocinando constitui & sanguinis ductus in ventriculi cavum pertinentes ejus aerem condensando comprimere, & sanguinem ab iis supportatum reprimere perquam gelidissimis potionibus: quia verò cujusquemodi generis cibos, sive ex contrito pane, sive ex recentium ovorum vitellis in gallinaceorum pullorum jusculis solutis, sive ex ptisana hordeacea oryzaeque cremore, æger morbo fufus stomacho maximoperè languente reddebat, sorbitiones virium imbecillitati succurrentes neque onerantes delegi: & primùm quidem ex chiocolatte; tùm ex vaccino lacte & saccharo; indè ex hoc & cremore ex dulcibus amygdalis, albique papaveris seminibus recens expresso: cujusmodi liquores frigoribus ex glacie & nitro congelati, scilicet modò unus modò alius, quinta sextave quaque hora ad uncias circiter septem hauriebantur, interpositis non multis quidem sed sæpè nocte ac die haud leviter sitienti datis ex frigida Nucerina aqua potionibus. Quæ curandi via maximè, quemadmodum ego arbitror, rationalis mirificè quum conferret, in ea perstiti ferè usque ad Februarii mensis proximè insequentis initium; quo tempore victum primis quidem diebus ex decocta in gallinaceo jusculo oryza, confcissove triticeo pane eodem jusculo benè madente, aut recenti ovo; in sequentibus verò diebus ex carnibus quoque modò gallinaceis modò vitulinis, & interdum ex avibus imperavi: prætereaque ad imbecillem stomachum confirmandum præscripsi tincturæ ex absinthio sine vini spiritu extractæ guttas

circiter sexaginta quotidie paulo ante prandium ex pimpinellæ herbæ aquæ cochleario sumendas.

Prætereo me tertio quartove morbi die vaccinum lac, butyro, ovi vitello ac rubro saccharo admistis in ultima intestina per clysteres infundi curasse, ad atrum sanguinem ex ventriculo ad inferiores partes defluentem educendum: quem propterea quod crassi ex fuligine pulveris formam habere animadverterem; à medicamentis ad cruoris in ventriculi caveam effusi concretionem prohibendam tollendamve in quocunque vomitu sanguinis ab aliis medicis præscribi solitis abstinere satius duxi, quàm iis propinatis ad effectum à curatione per gelidissimas potiones jam prosperè inceptum perficiendum vires adhibere ejusmodi quamfrigidissimarum cruorem cogentium sorbitionum viribus planè atque omninò contrarias.

Atque hac quidem ratione medendi ægrotantem ad desperationem redactum ex gravissima & periculosissima valetudine liberavi: cui, ne in eundem morbum deinceps relabatur, sanguinis uncias septem octove tertio quartove quoque mense mitti jubeo, plerumque ex brachiis, interdum ex hæmorrhoidibus. Istiusmodi autem præsidii genere ad sanguinis profusionem prohibendam utendi causa hæc est. Splenis scirrhus supra commemorato sanguinei ad eum attinentes ductus magnoperè obstructi eam sanguinis copiam cui continendæ apti creati sunt profectò capere nequeunt; reliqui igitur corporis, & quod consequitur, eò magis ventriculi ipsi lien propinqui canales sanguinem ducentes quantitatem ejus naturali majorem contineant necesse est: hique propterea sic extrorsum trudi ac dilatari poterunt, ut sanguini continenter ex ipsis manare conanti patefiant; sicuti plerumque contingit in maribus sceminisque, quibus sanguinis sputa, vomitus, aut ejus ex naribus profluvia propter insignes vasorum vel infimi ventris obstructions fiunt. Sed in lienosis præsertim copiosas & immodicas sanguinis fusque deque rejectiones vidisse se narrat Jo. Riolanus; historiasque ex Hippocrate & Valverda affert eorum qui sanguinis vomitu ex turgente splene interièrè. Id ergò malum ne accideret præcavendum mihi existimabam repetita sanguineæ materiæ detractiōne. Et quoniam sanguinis in suos ductus impetus velocitatis quoque incremento augeri potest; ob hoc & aquæ frigidæ potum vini loco, & abstinentiam à venatione, cursu, aliisque ejuscemodi cruoris motum vehementer accelerare potentibus imperavi, & eventu sanè ad ultimum usque mensem anni c15 15cc xxx. prosperrimo.

Nam eo anno postridiè calendas Decembris in eundem sanguinis vomitum noctu relabatur. Ad eum visendum protinus accitus; quandoquidem libram unam tantummodò alteramve sanguinis evomuerat, & plenitudinem boni adesse cruoris videbam: quanquam cruenta vomitio continuabat, & arteriæ sub ea penè ex toto sub mittebant sese; nihilominus tamen sanguinis uncias circiter decem ad eum à ventriculi sanguiferis vasis avertendum ex vena in lævo brachio secta, nulla interposita mora, mitti jubeo; indè liquidi Helmontii laudani guttas quindecim

quindecim octodecimve ex pimpinellæ minoris aquæ unciis quatuor sumendas præscribo ; atque hujusmodi remedium somni inducendi & cruoris velocitatis retardandæ causa in usum vocatum ter quaterve, quòd sanguinis vomitu redeunte rejiciebatur, ea nocte ad propositum mihi finem consequendum repetere coactus sum. Vomitus vix horas duas sub hisce auxiliis conquievit : eo autem semel iterumque reverso ex hæmorrhoidibus quoque sanguinem ad uncias circiter quatuor educi præcipio, eodemque tempore ad quamgelidissimas, (quæ aliàs felicissimè cesserant, optimèque nunc respondent in quadam virgine profusissimo cruoris ex uteri vasorum oppilationibus vomitu ferè exinanita) sorbitiones devenio : & primùm quidem ad chioccolatte, tùm horis circiter quatuor exactis ad alios congelatos liquores, quos sorbetti ex spumiglia & pappina vernacula lingua hîc appellant. Ex cujusmodi artificiali gelu concretis liquidis, nempè modò ex uno modò ex altero, ad coercendum vomitum viresque reficiendas, non multum quidem ne ventriculum morbo solutum oneraret, sed sæpè æger ferè exanimis degustabat. Hujusmodi per summè gelidas sorbitiones curandi ratione, cruoris maximè gastricis arteriis ac venis contenti motum valentissimè refrenare potente, obtinui ut vomitus ad insequentem usque diem quieverit ; in quo bis reversus iisdem quamgelidissimis potionibus pertinaciter tertia quartave quaque hora repetitis iterùm compressus est.

Tertio mali die sanguinem quidem, at non in multa copia, ægrotanti denuò circa vespèram vomenti, catapotia auri bracteis obvoluta, ad accersendum somnum & ad cordis atque arteriarum coagitationes præternaturales compescendas, devoranda ex aquæ tormentillæ herbæ succi unciis tribus dedi, quæ recipiebant persici philonii grana triginta, tosti opii semisrupulum. Hæc autem adeò responderunt ut & vomitus protinus sedatus sit & longiusculus somnus noctu accesserit. Dum hæc adversus sanguinis vomitionem gerebantur, alvus lacte, butyro, saccharo ac ovi vitellis commistis & in inferiores partes infusis secundo tertiove die ad nigrum sanguinem ex ventriculo ad intestina sub bilis atræ specie jam quoque delapsum evacuandum ducebatur ; aquaque prætereà ex millefolii succo, in qua cotoneum malum parumper ebullierat, glacie gelidissima reddita ad stomachum æstu suo languidum erigendum, ad ductus sanguinem in eum importantes confirmandos, & ad sitim quæ die tertio urgere cœpit moderandam sæpius die ac nocte, parcè tamen ne stomachus ipse tunc multum admodum infirmus ad resistendum obrueretur, potui dabatur. Dies duodecim frigidissimam hanc tenuissimamque victus rationem, sub qua flatus quamplurimi per inferiora maximo cum crepitu descendebant, satis feliciter adhibui : post quod tempus, quum de ventriculi distendente dolore ægrotus (quòd præmemorata glaciali aqua ad depellendam, qua continuò ardebat, sitim abusus effect) gravissimè quereretur, illam dimisi ; atque in ipsius locum substitui victum paulò pleniorum ex calidis gallinaceorum pullorum jusculis,

in

in quibus recentis ovi vitellus cum permollica succi ex limonio malo portione solutus erat. Quæ juscula bis in die hauriebantur, interposita summis matutinis temporibus benè calida ex chiocolatte sorbitione, cui frigida aquæ potio, tùm ventriculi refrigerandi tùm importunæ sitis elidendæ ergò, præmittebatur. Adversus autem istiusmodi permolestam stomachi distentionem præter calentes sorbitiones catapotia quoque modò proposita inordinatos nervorum, & animalium spirituum motus componendi virtute prædita propinavi. Quartodecimo die dolor & tumor ponè sinistram aurem ad inferioris mandibulæ medium & amplius sese exporrigens, posteaquam caput proximè antecedentibus diebus leviter doluerat, extemplò suboritur; eodemque tempore febris, quæ alioqui continens quidem sed nequaquam ingens erat, cum levi frigore & aliqua mentis turbatione intenditur. Contra quem dolorem calida humidaque fomenta ex vaccini lactis & aquæ simplicis, in quibus sambuci flores decocti erant, partibus æqualibus, spongiis admotis sæpè repetenda præscribo: per quæ humoris parotidam afficientis coitus intra octo dies ferè ex toto solutus est. Post quod tempus febricula circa noctem paulum increpescens, mane se remittens continuabat; æger siti non adeò cruciabatur, frigidam Nucerinam aquam potabat; interdiu vigilabat, noctu conquiescebat; calidis, quas dixi, sorbitionibus reficiebatur, & interdum ptisana quoque ex oryza utebatur. Natura vel dum benè valebat ructuosus, aliquando conquerebatur de quibusdam (ut ipse aiebat) acidis ventriculum irritantibus, pituitæ & nonnunquam alimentorum rejectum moventibus: adversus quæ absinthii tinctura semel die circa meridiem, sæpius frigida aqua ex Nucerino fonte huc importata haud improspere pugnabam; atque interdum remedio perfici philonii & costi opii; interdum quamgelidissima ex lacte & saccharo gelu artificiosè concretis sorbitione ad crebrò ructantem, calidisque fermentationibus (quod ut facile credam haud leves sunt causæ) commotum stomachum componendum prospero successu noctu utebar. Circa diem quadragesimum aquosi humoris vomitus decedebat; arteriæ naturaliter ordinatæ erant; venter quotidie satis, copiosam verò urinam vesica reddebat; & vires ac ciborum appetentia accedebant sic ut valentiorum cibum, frigidum videlicet ex cervino cornu & vitulinis pedibus gluten convalescenti, paulo antequam nutrientia juscula supra commemorata forberet, quotidie ter oporteret offerre. Ab ejusmodi alimenti genere primum ad oryzam in capi jusculo coctam & gallinacea jecinora elixa; indè ad tenerarum gallinarum, vitulorum, coturnicumque carnes transit: edulio ex vaccino lacte, recentis ovi vitello, & tantilla sacchari portione, ad cochlearium unum aut alterum commanducato alvi movendæ gratia. Atque in præsentia sanus est & benevalet.

Propositum sanguinis vomitum per congelatas sorbitiones suppressendi rationem quam solidissimis ratiocinationibus esse innixam demonstratu haud ità difficile est. Primum namque sanguiferi ductus sanguinem

sanguinem in ventriculi cavum, sive rupturâ, sive erôsione, sive raritudine propriarum tunicarum, sive orum suorum aperturâ profundentes, glacialis ejusmodi congelatarum celeriter in ventriculum defluentium potionum frigoris vi nulla re interposita tacti, quasque perusti, quàm citissimè validissimèque fieri potest corrugantur; tùm sanguis his ipsis ductibus contentus vehementissimè cogitur atque in majores canales repellitur; deindè toto corpore ob idem gelidissimum frigus inhorrescente, reliquum sanguinis in suis motibus lationis & agitationis multum admodum retardatur, ac proin ejus impetus ex cordis & arteriarum pulsus velocitate enascens, arteriosorum venosorumque canalium extremis orificiis patefaciendis peropportunos notabiliter imminuitur; postea illæ ipsæ quamgelidissimæ potiones ex satis nutrientibus massulis coagmentatæ per notissimas chyli vias sanguinis alveos influentes residui cruoris particulas congregando absque ullo impetu reficiunt. Quum igitur ea quam expono adversus sanguinis vomitum pugnandi ratio & ventriculi vomendi conatus cohibere & sanguinem sistere pluribus de nominibus valeat; subveniendique insuper et promptè quidem imbecillitati ægrotantis sufficienti virtute polleat: ecquis saniorum saltem medentium jam est qui eam et maximè rationalem & efficacissimarum in cruorem vomentibus virium esse non fateatur?

Pulcherrimam Aretæi ex Cappadocia græco-latinam editionem Oxonia ad me transmissam inspicienti mihi sanguinis rejectionis curatio acutorum morborum libro secundo ab eo proposita sub aspectum venit. Quum autem hanc perlegerim ad eum locum deveni ubi “ præsentiorē medicinam in iis quæ bibuntur & devorantur” esse ait, quorum speciem triplicem existere subjicit; “ vel ut vasa cogendo “ compremendoque fluxionis ductus quasi ligent; vel ut effluentem “ humorem incrassent atque congelent, quo minus effundatur quam “ quam exitus pateat; vel ut vias exsiccent, sanguinem intrâ sedem “ antiquam retinendo, ne profluvio loci exinaniti maneant, & in “ eam partem exundent ubi facta est effusio.”

Miles ille in græcorum veterum medica disciplina gloriarum plenissimus, qui cujusdam G. Schmidt Corcyræ nigræ ficti medici cognomine personatus, clamoso libello ranæ ad instar clamitans ranuncolorum vim maximam hos ante sex annos in me commovit: miles inquam ille ex hisce Aretæi verbis: “ cogendo comprimendo; quasi “ ligent atque congelent;” colligi posse, quòd sanguinis vomitum, cujus historiam cum medica republica communico, curandi methodus sola ratione hoc in casu à me inventa in ejusdem Cappadociæ medicorum principis de curatione sanguinis rejectionis capite continetur, procul dubio dictitabit. Verum enimvèro id à veritate omninò abhorreere evidentissimum fiet remedia, quæ valida & ad concretionem efficacia idemet vocat Aretæus, perpendenti. Non enim glaciem, nivem, aut quos ego adhibui congelatos liquores ad vasorum compressionem, & sanguinis, quam cæteroqui necessariam cognoscis,

noscis, concretionem inducendam proponit, sed simplicem “poscam; plantaginis, uvæ acerbæ, sanguinalis herbæ, feridis, coriandrive cum aceto succum; aridam acaciam; leporis, hinnuli, aut hoedi coagulum; terram Samiam, Etreriam, sigillatamque Lemniam; corallium, sapam Creticam, pastillos ex Ægyptia spina,” atque hujus generis alia multa quæ hîc referre piget. Quod ad alimenta attinet: ea adstringentia quidem, & facultate refrigerantia vel tactu frigida esse debere scribit: at verò mentionem tantummodò injicit “elotæ alicæ, oryzæ in posca, palmularum decocti, tosti panis sicci contusi, in farinæ speciem cribro trajecti”: ex quibus “sorbitiones cum oleo (cui thymbra inspergi potest sale condita cum rhoe) faciendas esse præcipit. Si ex profusione mors timeri possit: injucunda etiam & concoctu difficilia esse præbenda, ex galla arida contrita lenti siccæ frigidæque inspersa atque ova inter coquendum crassa effecta” tradit. Atque his utendum esse inculcat si adstringere & refrigerare in animo habeamus. Sanguinem autem & spiritum incrassantia auxilia recensens: ad hoc præstandum “sorbitiones ex lacte, amylo; aut ex alica modò cum amylo, modò cum lacte; alicamque præterea cum palmulis coctam, & ad consistentiam optimè perductam cum amylo, vel lacte, vel farre Thyrræno; itemque milium cum lacte,” atque horum similia maximè valere perhibet. Itaque quum Aretæi neque alimenta neque medicamenta adversus sanguinis vel à liene profusiones congelatiatarum, quas meo ægrotanti cum rejectûs sanguinis suppressendi tum virium levissimo gratissimoque cibi genere sustinendarum causa dedi, sorbitionum virtutibus æquales similesve obtineant facultates; hæque ab illis plurimùm differant: nemo deinceps suspicari poterit meam antè recensitam sanguinis vomitum per quam gelidissimas, summis frigoribus, propinatas potiones edomandi comprimendique methodum ab Aretæi fontibus emanasse. Si in supra allegatis Aretæi verbis eam curandi viam reapse subesse miles novisset: eam profectò quatuor circiter abhinc annis, nimirum dum patricio nostro sanguinem copiosissimè primùm evomenti unà cum aliis medicis assideret, adhibuisset. At sub ejus curandi forma per largas repetitasque sanguinis detractiões, & medicamenta nitrum recipientia ex Stahlio excerpta æger longo vitæ curriculo dignissimus moriturus esset: mea autem opera à mortis limine revocatus est. Sed philogræculum dimittamus: ad glaciali frigore curandi rationem revertamur.

T. Bartholini de nivis usu medico libellum nuperrimis diebus quum evolverem, inveni non Abensinam modò potionem nive refrigeratam in calidis ventriculi passionibus imperare, sed & Galenum. Hic, eodem referente Bartholino, Senecam “solutum & æstu suo languidum stomachum perurente frigore erigendum esse” in naturalibus quæstionibus scribentem fortasse secutus: in ventriculo curando refrigerationem sibi proponit per aquam, cibos, fructus nive refrigeratos.

ratos. “† vidisti, inquit, & tu quosdam uno die, vel potius hora, “ frigida potione levatos; quorum aliis non aquam modo dedi fontanam recentem, sed etiam quæ nive esset refrigerata, veluti Romæ “ præparare solent: cibos præterea ad eundem modum refrigeratos “ identidem me illis permittere vidisti: iisdem dedi & ptisanam “ probè coctam pari ratione refrigeratam, aliaque id genus sexcenta.”

Præter Abensinam & Galenum, Rhafem quoque Zacutum Amatunque Lusitanos, Lud. Septalium, Laz. Riverium atque alios, qui ad percalidum ventriculum multùm infrigidandum colicosque ex calidis ac biliosis humoribus coortos dolores depellendos cibo & potu gelido & frigida aqua in linteolis ventri imposita usi sunt, adducit idem Bartholinus: qui autem sanguinis rejectiones effluentiasve ex quacunque corporis nostri parte potionibus nive vel glacie quam frigidissimis redditis, aut alius generis gelidissimis sorbitionibus curaverit, profert neminem. Quod ad me attinet: congelatos ex melonum seminum cremore & modico saccharo liquores parca manu circà primum vesperum oblatos satis feliciter hisce frigidissimis diebus expertus sum in juvenilis ætatis & fervidæ temperiei moniali, quæ ventriculi nervorum spasmo a vehementi mœstitia ortum ducente lævumque ejus orificium ità constringente ut & gravem suspiriosamque respirationem efficeret, & cùm esculentorum tùm potulentorum vel parcissimè assumptorum descensum penè ex toto prohiberet, graviter vexabatur.

Hippocrates, quanquam “ frigida veluti nivem & glaciem sanguinis eruptiones inducere” scribit aphor. sect. v. aph. xxiv. nihilo tamen secius aphor. xxiii. asserit: “ in his frigida uti oportere, unde “ sanguis eruptus aut erupturus est, & quidem circà ipsas partes unde “ fluit.” Memini me sex circiter abhinc annis sanguinis ingens ex utero profluvium, communibus medicamentis & ne perfrigida quidem aqua quicquam proficientibus, promptissimè in matrona media æstate suppressisse, perurente glacie genibus & cruribus super-imposita, cruralibus & iliis aliisque in uterum desinentibus arteriis ac venis maximopere coarctatis, repressoque propterea ac veluti a consuetis viis intercluso sanguine. Verumtamen tametsi quam gelidissimas sorbitiones adversus cujusquemodi profluvia sanguinis, & maximè ex ventriculo, ab immodico sanguinei amnis fervore & accelerato motu enata aut cum his conjuncta, & in juvenibus potissimùm quibus cruor & stomachus exæstuat, magnoperè collaudo; non ideò tamen suadere ausim ut illæ ipsæ congelatæ sorbitiones mulieribus sanguinem ex partu vomentibus, aut frigidis ventriculi atque intestinorum fermentationibus obnoxiiis sine ullo discrimine propinentur. In sanguinis ex partu vomitionibus, uti neque “ multa calida aqua lavare neque tepefactoria” (quemadmodum Hippocrates tùm in

† Lib. vii. Met. Med. Cap. iv.

libro de morbis muliebribus, tùm in eo quem de natura muliebri inscripsit indiscriminatim præcipit) tam faciliè adhiberem; sic asininum & vaccinum lac ab eodem Hippocrate iis in casibus præscriptum haud quaquam planè damnam. Sanguinem, inquam, ex lochiorum suppressione aut imminutione evomentibus; primum venas in pedibus secari ad sanguinem à ventriculo revocandum tùm calidis fomentis ex aqua & albo vino, in quibus emollientes aperientesque herbæ ebullierint, hypogastricam regionem frequentissimè foveri, cruraque & pedes eodem tempore multa calida aqua lavari juberem ad uteri vasa referenda; inde ad lac, humectandæ & reficiendæ sanguineæ massæ causa, transirem. Sin verò mulieri sanguinem vomendo rejicienti puerperii purgationes naturaliter fluere, non calidis fotibus & lavacris, sed remediis sanguinis impetum sedantibus, ejus calorem cogendo moderantibus, confirmantibusque vasa ventriculi, ad singulas circumstantes res attentè respiciendo, cruentum vomitum suppressere pertentarem. Eo autem compresso ad lacteam diætam, vel hac non conferente ad reficientes potiones ex chioccolatte, nutrientibus gallinaceorum pullorum, ranarum, terrestriumve testudinum jusculis, atque horum similibus devenirem.

*Laurel-water
poisonous. By
Dr. T. Mad-
den: n. 418.
p. 84. March
&c. 1731.*

III. 1. **A**N accident that happened here some months ago has discovered to us a most dangerous poison; I mean the simple water distilled from the leaves of the lauro-cerasus. The water is at first of a milky colour, but the oil which comes over the helm with it being in a good measure separated from the phlegm by passing it thro' a flannel bag it becomes as clear as common water. It has the smell of the bitter almond or peach-kernel, and has been for many years in frequent use among our housewives and cooks to give an agreeable flavour to their creams and puddings. It has also been much in use among our drinkers of drams in the proportion of one part of laurel-water to four of brandy. Nor has this practice (however frequent) ever been attended with any apparent ill consequences, till some time in September 1728, when it happened that one M. Boyse, a maid-servant who lived with a person that sold great quantities of this water, got a bottle of it from her mistress and gave it to her mother A. Boyse as a very rich cordial. A. Boyse made a present of it to F. Eaton her sister, who being a shopkeeper in Dublin, gave about two ounces of it to one M. Whaley who had bought some goods of her. She drank about two thirds of what was filled out and in about a quarter of an hour after complained of a violent disorder in her stomach. She was carried home, and from that time lost her speech, and died in an about an hour, without vomiting, purging, or any convulsion. F. Eaton sent to let her sister know what had happened; she came immediately and affirmed that it was not possible the cordial (as she called it) could have occasioned the death of the woman; and to convince her filled out about three spoonfuls and drank it. She continued talking with F. Eaton about

about two minutes longer, and was so earnest to persuade her of the liquor's being inoffensive that she filled out two spoonfuls more and drank it off. She was hardly well seated in her chair when she died, without the least groan or convulsion. F. Eaton, who had drank somewhat above a spoonful, found no disorder at all, but to prevent any ill consequence took a vomit immediately and has been well ever since. M. Whaley was buried without being examined by any but the coroner. I went to see A. Boyse about twenty-four hours after her death, but could not prevail to have her opened. She was about sixty years old; her countenance and skin appeared well coloured, and her features were hardly altered, so that she looked like one asleep. Her belly was not swelled, nor had she any other external mark of poison. This accident brought into discourse another of the like nature which happened about four years since in the town of Kilkenny. A young gentleman of that town mistook a bottle of this laurel-water for a bottle of ptisan. What quantity he drank is uncertain, but he died in a few minutes, complaining of a violent disorder in his stomach. This affair was not much regarded at that time, because he laboured under a distemper to which, or to an improper use of remedies, his death was attributed by those about him.

To satisfy myself farther as to the effects of this poison I made the following experiments in conjunction with a few of my friends. 1. Octob. 3, 1728. we gave a large setting-dog three ounces of laurel-water by the mouth. In three minutes he began to be strongly convulsed, and continued so about five minutes; I untied him, and then he fell into a most violent difficulty of breathing, which lasted about eight minutes and abated gradually; upon which he endeavoured to raise himself but could not. I tied him down again and gave him an ounce and an half more, upon which he sunk at once, and without any return of his convulsions or difficulty of breathing expired in two minutes. Opening the stomach I found in it the whole quantity of water which he had taken; its surface was covered with froth, but it was not otherwise altered in its colour, consistence or smell. The inside of the stomach was not at all inflamed, nor was there any visible alteration in the tunica villosa. The veins of the stomach, all the mesaraic veins, and likewise the vena cava, were much distended with blood; the arteries, on the contrary, were remarkably empty. The liver and gall-bladder were no way altered. The kidneys were unusually full of blood, and appeared of a bluish colour, almost as deep as that of the violet plumb. Upon making an incision into one of the kidneys the blood flowed in much greater plenty and was more fluid than usual. In the heart there appeared nothing præternatural. The brain was no way altered. 2. Oct. 24. we gave an ounce and an half of the same water to a bitch of a smaller size. She was immediately let loose and in two minutes lost the

use of her limbs. She attempted several times to raise herself and walk, but she staggered and reeled about and then fell down. She repeated this without ceasing about five or six minutes. At last she was violently convulsed, especially in the muscles that extend the head and spine. About the space of a minute she had that sort of convulsion called the opisthotonos, the back of her head being drawn almost to her tail. After this she vomited plentifully and her convulsions ceased. She then lay still for seven or eight minutes, labouring for breath (though not so violently as in the former case) and foaming at the mouth. We gave her an ounce more of the water; upon which her difficulty of breathing encreased and she died in two minutes. Upon opening the abdomen, the thorax and the head, we found every thing in the same state as in the former instance. 3. Oct. 25. we gave two ounces of the water to a dog of the same size with the former, which produced the like appearances as in the foregoing case. This dog was dying half an hour; for the dose was not repeated because he did not vomit up what he had taken. Upon opening him we found every thing in the same state as in the former instance. 4. Oct. 26. we gave two drams and an half of the water to a dog of a middle size, and immediately untied him. He then ran about the room very briskly for about a minute, and seemed to be no way affected with it; yet he soon lost the use of his limbs. He often attempted to raise himself and walk, but still fell down again before he had moved two yards from the place. After this he vomited plentifully, considering that he had fasted twenty-four hours, upon which he was seized with a convulsion more violent than any of the former dogs, especially in the muscles that extend the head and spine. These convulsions continued about eight or ten minutes; upon their ceasing he lay still, breathing deeply though regularly, and seemed to be asleep. In about ten minutes he raised himself, took some food, and walked about tolerably well. We left him, and returning after three hours found him perfectly recovered. 5. Oct. 28. we injected an ounce of the water into the intestinum rectum of a strong spaniel dog and let him loose. In the space of two minutes he began to lose the use of his limbs, and to stagger as the others had done. He was convulsed more violently than any of the rest, and chiefly in the muscles of the neck and spine. The muscles of his eyes were strongly convulsed, which appearance was not observed in the other dogs. He foamed at the mouth, yelled frequently, and breathed with more difficulty than any of the rest. His convulsions continued twenty minutes; upon their ceasing he lay quiet as though he slept, only that his eyes were open. His limbs were now grown perfectly paralytic. We raised him up several times and set him on his legs, but he did not attempt to use them. He continued in this way about fifteen minutes longer, and then was seized with another violent convulsion which in five minutes put an end to his life. Upon opening
the

the abdomen we found the veins of the stomach and guts very much distended with blood, as in all the former instances. In the heart, lungs and brain there was no visible alteration. 6. Oct. 30. we injected an ounce and an half of the water diluted with three ounces of common water warmed into the anus of a small bitch. Before we could untie her she was seized with convulsions and yelled much. She fell as soon as she was let loose, and never after endeavoured to rise. She had convulsions and great difficulty of breathing about two minutes. She then lay still, with her limbs stiff and extended, about three minutes; during which time her lower jaw was convulsed and pulled alternately to and from the upper jaw with a very quick motion. After this her limbs became paralytic and she gasped for breath about two minutes longer. She was quite dead in seven or eight minutes from the injection of the clyster. In the abdomen, thorax and brain every thing appeared as usual. 7. Nov. 2. we injected half an ounce of the water dilated with three ounces of common water warmed into the anus of a small bitch. In the space of four minutes she began to breath with difficulty. We let her loose, but she was not able to stand without stumbling. The muscles that extended the head were convulsed, and her fore-legs were affected for three or four minutes with a tetanus, but had no convulsive motion. She vomited and purged plentifully. She did not yell nor seem to suffer much pain, nor did she lose her senses all the time. In half an hour she recovered. 8. The next day we injected a drachm of the water into the external jugular of the same bitch. She was seized with convulsions as violent as the former before we could untie her. They lasted about five minutes; after which she recovered gradually and continued well. 9. Nov. 20. we injected four ounces of the water by the anus, without any dilution, into a strong dog of a middling size. He was seized with convulsions and difficulty of breathing in less than two minutes after the injection. He fell to the ground as soon as his convulsions began, and never once attempted to rise; nor were his convulsions in any sort so violent, neither did they continue so long as in the former instances. He bled at the nose about four spoonfuls. The blood was of a very bright florid colour. His convulsions lasted about four minutes; after which he became entirely paralytic and died in three minutes more. We found the stomach, intestines, liver, &c. in the same state as those above-mentioned. Upon cutting about an inch from the lower part of one of the lobes of the lungs, the blood flowed from it in great plenty, and appeared more florid and fluid than usual. 10. Dec. 14. we gave five ounces of laurel-water by clyster to a dog somewhat of the size and shape of the Italian greyhound. He seemed at first to be no way affected with it, but in about five minutes he began to droop and lose the use of his limbs. He did not once yell or struggle as the others had done, but sunk gradually
till

till he became at last entirely paralytic. He had not any convulsion, except a kind of spasmus cynicus a few minutes before he died, which happened in half an hour after the injection of the clyster. Upon opening the abdomen we found the veins much distended with blood, as were also the veins and sinuses of the brain. 11. Dec. 19. we gave three ounces of the water in the same manner to a cur of the lap-dog size. He died in seven minutes without any convulsion, except a tetanus in the muscles that extend the head. 12. The laur-cerasus being an ever-green and abounding with a warm essential oil, we imagined that other ever-greens might partake of the same poisonous quality. Accordingly we tried a water distilled in an alembic from the leaves of the yew-tree so much talked of by the antients, and whose very shade they supposed to be fatal to those who sat or slept under it. We gave three ounces of this water by clyster to a very small cur dog, but he was not in the least affected with it. 13. We also gave by the mouth two ounces of a water distilled from the leaves of the bay-tree, to a young spaniel, without any effect. 14. We afterwards made an experiment with the distilled water of box-leaves, which had a very strong narcotic smell. We injected five ounces of this water by the anus into a small cur dog, but he was no way affected with it though we kept him twelve hours after the operation. 15. Being desirous to know whether the virulency of laurel-water was owing to the fire in distillation, we poured warm water upon some laurel-leaves bruised, and made a strong infusion of them. We poured an ounce of it down a dog's throat, half of which was supposed to enter the stomach, and five minutes after another ounce was given in like manner. The dog seemed to be somewhat sick at his stomach, but was soon as lively as ever. A few minutes after this another ounce was given him by the mouth, of which we suppose a fourth part to have been lost. He soon after stared and trembled very much. In five minutes another ounce was exhibited, upon which he trembled as before, but in a little time he appeared easy and lively. Imagining that these small quantities lost their power during the intervals of giving them, in ten minutes after his taking the former dose we poured down his throat two ounces and a half at once. He immediately fell on his back convulsed and tumbled over three or four times, but quickly returned to his feet. He staggered, his eyes stared, and he sat down like a dog that is tired. At length he shut his eyes, his neck became extended, and we apprehended he was falling into convulsions; but instead thereof he vomited a vast quantity of indigested chyle, in which appeared a great part of the infusion; after which he seemed to be perfectly recovered. 16. In about twenty-five minutes after this we gave the same dog by the mouth two ounces of the juice expressed from laurel-leaves, and in about ten minutes more another ounce was given him in the same manner. In a few minutes he began to lose the use of his hinder legs, but

but quickly recovered them. Upon his taking another ounce soon after the former he fell into a great difficulty of breathing, and yelled much. After this he was seized with very strong convulsions which affected his lower jaw and hinder legs most remarkably. In about the space of five minutes these convulsions were succeeded by an entire resolution of all the limbs. He breathed with great difficulty and very slowly. No appearance of expiration. Sometimes we observed two attempts at inspiration without intermission or closing of the mouth. At other times there was near the space of a minute between two inspirations. After this he was seized with a trembling in his limbs, and in about three quarters of an hour from his taking the last ounce he died without any struggling with his tail extended.

There were several other experiments made of the same kind, by some gentlemen of the profession here which corresponded exactly with the foregoing, excepting this one circumstance, that they were of opinion this poison occasioned an inflammation in the stomach and guts. Towards clearing this dispute we who thought otherwise put together the following hints, from which it appears that the fact is not as they imagined, and that notwithstanding we find, upon an animal's being killed by this poison, the veins greatly distended with blood, yet there is not any inflammation produced by it. I do not know any thing that will illustrate this matter better than the analogy which may be observed between the convulsions occasioned by the epilepsy and those which are the effect of laurel-water. For instance, in the epilepsy the body is universally convulsed, especially the muscles of the neck, the tongue, the lower jaw, and those of the arms. The effect of these convulsions is this: the heart beats with unusual violence and frequency, the necessary consequence of which is that the blood will be thrown in greater plenty from the arteries into the veins. But because the muscles compress the veins more than the arteries (whose systole enables them to overcome that pressure) therefore the blood, which is still pushed forward by the systole of the heart into the veins, will be retained there by the aforesaid pressure of the muscles, and will return in a very small quantity to the heart. For example; the abdominal muscles being convulsed press the stomach and intestines upon the vena cava ascendens and the vena portæ; by which means the blood returning from the lower extremities is retained in those vessels. Accordingly we see the visible and immediate effects of this pressure are the forcing out the excrements of the bladder and intestines, and very frequently the profluvium seminis. In like manner the pressure of the muscles of the neck, tongue, and lower jaw upon the jugular veins and their branches, will not suffer the blood to return to the heart by the vena cava descendens. To this we may add the pressure of the diaphragm and ribs upon the lungs, by means whereof the trunks of the vena cava ascendens and descendens are compressed at their insertion into the heart.

heart. Hence follows that frightful blackness of the face during the paroxysm, and the prodigious swelling of the veins of the head, especially the temporal. The necessary consequence of all this must be that if the convulsion lasts long enough the man must die, on account of the blood's being thrown out of the arteries into the veins and not returning to the heart. And I make no question that if such a person was opened after death we should find the vena cava, the vena portæ, the veins and sinuses of the brain, together with all their smallest ramifications, very much distended with blood, and the arteries on the contrary almost empty. But if the epileptic convulsion ceases before the circulation of the blood is entirely stopped then all becomes calm again, the pressure is taken off the veins, the blood returns to its usual course, and in a few hours the sick person is perfectly recovered. And yet all this violent convulsion of the body, this prodigious distension of the veins and interception of the course of the blood passes without any inflammation, as appears from the speedy recovery of the sick person: for if the convulsion had occasioned an inflammation a fever must necessarily have ensued, which would discover itself by manifest tokens and would require a much longer time for its abatement.

Let us now observe the analogy between these appearances and those produced by laurel-water. We find by exper. 4, 5 to 11. that an ounce, or even two drachms and a half of laurel-water will occasion more violent convulsions than three ounces, or even five of it. If therefore an inflammation was the necessary consequence of this water being taken into the stomach or guts, the more violent the convulsion is, the greater the inflammation ought to be. On the contrary we find by exper. 4 to 7. that the more violent the convulsion is the greater is the probability that the creature will recover; and when it so falls out, the manner is exactly the same as in the recovery of an epileptic person. In a few minutes the creature becomes as brisk as if no such thing had happened. Now if an inflammation was at all the necessary consequence of this poison, though the creature recovers yet there must be some inflammation, greater or less, produced, which must occasion more violent and lasting symptoms. But since none such appear, since the recovery is so sudden and effectual, it is the strongest and plainest argument that there is not any inflammation produced. If the laurel-water is administered to the quantity of an ounce or more the creature unavoidably dies in a few minutes, and upon opening the appearances are these. Both the trunks of the vena cava and all the ramifications of the mesaraic veins are greatly distended with blood. These vessels are easily distinguished from the arteries, not only by the thinness of their coats but also by the colour which the blood exhibits to the eye. Now I conceive that all inflammations have their beginning in the arteries, and that they are produced because there is no free passage for the blood into the veins.

But if once this passage becomes free (as in this case it surely is; for we find all the veins distended with blood beyond their natural dimensions) the inflammation is then at an end, the cause which produced it being taken off. Moreover, the fact laid down, that the veins are præternaturally distended with blood, does necessarily conclude that the arteries are not distended with it, and consequently that there cannot be any inflammation; for if the quantity of blood is encreased in the veins, it must be proportionably diminished in the arteries. To what has been said we may add the following observation, that if there was any inflammation produced by this poison it ought to appear most remarkable on the inside of the stomach and intestines, because of the immediate contact it has with those parts. All other poisons which occasion inflammations in the stomach and guts do first operate upon the blood-vessels and corrode the parts inflamed. They occasion vomitings and fluxes of blood, which at length terminate in convulsions. One may very easily be deceived upon opening the stomach of a dog, and may mistake the redness of the tunica villosa for an inflammation. The inner coat of a dog's stomach is naturally of a ruddy flesh-colour, and therefore of all domestic animals a dog has the quickest and strongest digestion. Accordingly they swallow bones and digest them perfectly well; and although they are but half chewed when taken into the stomach, yet they are at last reduced to as soft a consistence as any other part of their aliment. It is for this reason that the stomachs of dogs are more plentifully supplied with blood than those of other animals; by which means not only the muscular force of the stomach, but its warmth also, which is the principal instrument of digestion, is very much increased.

III. 2. **B**ole, vinegar and milk were separately given to three dogs which had swallowed some of the laurel-water: the bole and vinegar were not observed to do much good, but the dog which drank about a pint of milk recovered without any bad symptoms.

An antidote to the laurel-water. By Dr. J. Ratty. ib. p. 100.

III. 3. **I**Took a peck of laurel leaves and put them into an alembic with three gallons of water, which I distilled in the common way. The fire at first being too hot, there came over an oiliness with the water (1.) which made it appear milky till about half a pint had run: this tasted and smelt very strong like apricot kernels, as did the next running (2.) which was clearer. I kept the first quart by itself; then I drew off another quart (3.) which was not near so strong in taste or smell, but rather resembled black-cherry water: The remainder was almost insipid. The leaves after the distillation look'd brownish, were brittle, and tasted bitter without the roughness or apricot-kernel flavour, which they have while fresh.

Further experiments with laurel-water. By Dr. C. Mortimer. n. 420. p. 163. Aug. 1731.

In the afternoon of the same day I took a mungrel puppy, weighing two pounds and an half, about sixteen days old; it had suck'd the bitch in the forenoon, but had now fasted six hours. I gave it

half an ounce of the third water by tea-spoonfuls that it might the better swallow it, and then let it go; it walked about pretty strongly for five minutes, when it began to foam at the mouth, and soon after vomited up some curdled milk, and then discharged the *fæces alvinæ*, after which the sickness seem'd to go off: I gave it three tea-spoonfuls more; in ten minutes it began to stagger, and draw its hind parts after it; it sat upon its breech, whined, and made several efforts to vomit, but never brought any thing up; and then again would walk about, and sit down and whine, and again seem to recover for about fifteen minutes longer. Thinking the second water would dispatch it sooner, I gave it three tea-spoonfuls of it, and in two minutes time it became strongly convulsed, put out its tongue and made strong efforts to vomit, but to no effect; it could not stand, but lay with its hind legs stretched out: five minutes after I gave it three tea-spoonfuls more, when it was more strongly convulsed, rolled over and over several times, drew its head back to its rump, then lay on its sides and panted much: about eight minutes after I gave it two tea-spoonfuls more, and it had fresh and strong convulsions, but kept lying on its side and stretching out its legs one after another, drawing in its flanks very quick; in fifteen minutes more it died, being in all about an hour from the first dose. An hour after it was dead I opened it, and found all the contents of the abdomen well; the stomach was distended with wind, appeared empty of milk, but full of froth and a clear mucus of a much thicker consistence than the liquor gastricus naturally is; they had no smell at all, nor was the inside of the stomach at all inflamed. Opening the thorax I found the lungs a little redder than natural, with some vessels on their outward membrane very turgid: on cutting them out a pretty deal of clear red blood ran from them. The veins and both ventricles of the heart were turgid and full of coagulated blood of a dark-brown colour, which tinged my fingers of a dirty yellow, as if some gall had been mix'd with it. There was no blood in the arteries; the foramen ovale was open. On opening the head the dura mater appeared livid, as if bruised, its vessels and the sinus falci-formis were turgid and full of such blood as the heart and vessels near it. The cortical substance of the brain looked of an unusual livid colour.

Next day about five in the afternoon, I took a large fierce mastiff dog weighing seventy-five pounds, and injected per anum three ounces of the second running: in five minutes he trembled and stagger'd much, would let us handle him, drew his hind legs after him, tumbled on his head, panted and flabber'd, but gradually recover'd so as to stand up, tho' reeling and often sinking with his hind legs. Fifteen minutes after we injected one ounce more; he immediately stagger'd and sunk behind, made a great quantity of water, and soon after discharged the *fæces alvinæ* plentifully but of an hard consistence: the *fæces* seem'd moisten'd with the last injected

ounce,

ounce, which I imagined came away by this stool; I therefore immediately injected another ounce, upon which he seem'd more uneasy than before, tumbling on one side, and in about ten minutes fell fast asleep, breathing with difficulty; half an hour after I roused him, found him flabbering, drowsy, sinking behind, and giddy: about an hour and a quarter after the first injection I found him as before, but provoking him with a stick he bit at it, and tho' naturally fierce was very quiet when I did not strike him; in a few minutes he reeled and fell a snoring again: about nine at night he seem'd very well, only drowsy. We left him all that night without water and victuals, but thro' hunger he eat some of the straw he lay on, as we found afterwards upon opening his stomach. Next morning we gave him water and bones; he drank greedily and eat the bones, bread, and whatever was given him, seeming perfectly recovered and well all day and the next night, only very thirsty and a little drowsy, but perfectly gentle.

About nine next morning I gave him three ounces of the second running at three times with an horn, such as they drench horses with; he swallowed it with great difficulty and guggled some up again: he instantly reeled, fell down, rolled over and over, discharged much urine, and some hard *faeces alvinæ*, had no motion to vomit, but dribbled much, panted, and shewed great difficulty of breathing, snuffing up the air with his nostrils, holding his nose up, as he sat on his breech; for he could not then stand on his hind legs: he often shook his head as if stung by some fly: he gradually recover'd, and in about twenty minutes time could walk about very steadily on all his legs, tho' he still appeared weakest behind: I gave him three ounces more, near half of which he spilt; and indeed out of the six ounces I don't believe above three or four enter'd his stomach: he gave one very loud howl, sunk at once and never offered to rise again, but lay on one side, panted, hung his tongue out, and flabber'd much, stretched all his legs out three or four times, and was quite dead and motionless in about five minutes. I did not observe any convulsion in the muscles of the neck and back, nor was his head and tail drawn nearer together as in the puppy. About half an hour after I opened him, being still warm. I found the bladder contracted and empty: the rectum slightly inflamed, the small guts not distended with wind, but contracted and almost close; the bile was evacuated in great quantity into the duodenum, and was very thick, appearing like congealed honey; the gall-bladder was almost empty; but what remained in it was as thick as the other; to the inside of the gall-bladder there adhered several excrescencies in form and size of lentils, like drops of softish yellow wax: the liver was exceedingly inflamed, and almost livid: the stomach was contracted near the pylorus, and again about three inches above it; we found in it some pieces of bone, a pretty deal of straw, and about two ounces of fluid, which smelt strong of the laurel-water, but no

mucus, as in the puppy : some of the villi seemed slightly inflamed, the blood vessels being very turgid : there was a great deal of mucus in the œsophagus, which did not seem inflamed ; the lungs appeared exceedingly contracted, very red and inflamed. In this dog it was very evident that the pericardium did not adhere to the diaphragm as in erect animals, there being a distance of above two inches filled up by an appendix to the right lung ; on removing which the vena cava ran from the diaphragm about three inches to the pericardium quite free, not adhering to the back by any fibres or membranes, and was entirely enveloped by this appendix of the lung. The vena cava and all the veins were vastly distended, and the blood in them coagulated tho' the body was yet hot : there was little or no blood in the aorta ; only on pressing it a small quantity of a transparent fluid, which I took for serum, flowed out of it. The blood was strongly coagulated in the right auricle and ventricle of the heart, being of a very dark colour, and filling them quite ; but the left auricle and ventricle contained only a small clot of congealed blood which looked more red and florid : I kept some clots of blood taken out of the vein and the left ventricle twenty-four hours, but neither of them liquified or run into serum. I had the head cut off, but business preventing I did not open it till twenty-four hours after ; a great deal of blood drained from it, and upon opening it the vessels did not appear distended, but the dura mater looked livid : there was no blood at all in the sinus falciformis ; the brain looked very well ; the vessels of the plexus choroides in each ventricle were not distended but livid, nor were they burst, there being no extravasation in the ventricles, only a very small quantity of lymph ; which was the case likewise of the pericardium, which had not above a tea-spoonful of water in it.

In both these instances this poison seems to act by coagulating the blood ; so that it can't pass the lungs or brain : and I take it that the puppy lived longer than the great dog, because its foramen ovale was open, by which the thickened blood could pass, and perform a few circulations more than it could have done had it had the lungs to pass through ; and that in the puppy the brain was the part most affected, as was evident from its convulsions : whereas the dog was little convulsed, but seemed to die of a difficulty of breathing ; and the greatest accumulation was found at the right ventricle of the heart.

I got a middling-sized spaniel, and poured some laurel-water down his throat : he struggled pretty much at first, and whined ; but when he had swallowed about an ounce and half he ceased struggling ; that he might not be too long a dying the remainder was given him ; he spilt about one third of the whole quantity : he was then laid down on the ground, never offered to get up, but stretching out his legs expired presently. Mr. Ranby opened him
immediately ;

immediately; there was about two ounces of the laurel-water found in his stomach, and some frothy mucus; the veins in general were very turgid, but the blood was still fluid; and indeed we could discern no alteration in any of the viscera.

I gave four ounces of laurel-water to Dr. Porter, who forced down a pretty large dog three ounces. The creature instantly returned about two ounces by vomit, clear and unaltered; in a few minutes he grew prodigiously convulsed, soon after became motionless, and to all appearance was dying. Within ten minutes he vomited a second time, and threw up a small quantity of a viscid, green, and very frothy matter: from which moment he began to recover, and within half an hour was perfectly well. He was kept in the yard all night, and next morning not the least disorder appearing in him he was turned out of doors.

About half an hour after six in the evening I gave about half an ounce of the laurel-water to a middle-sized spaniel weighing near sixteen pound, which he swallowed with great reluctance. He remained about a minute and half on his legs; he then began to reel, and in about three minutes more fell into most violent convulsions, and his neck and tail were strongly drawn toward each other; he neither vomited nor purged, but we expected he would expire every minute the convulsions being so exceedingly strong, when some of the company called for some milk in order to try whether it would prove an antidote to so desperate a poison. We poured a little into his throat, which at first he could not swallow, but guggled it up again as if almost strangled with it. After several trials he began to swallow some, about a spoonful at a time, and seemed a little relieved, his convulsions leaving him, only fetching his breath very hard; but he lay still and snorted as if in a profound sleep; and the milk frothed out of his nose: on rousing him he opened his eyes and swallowed the milk better, which seemed to revive him much; so that the company imagining he would entirely recover went away. I staid some time longer till at last he began to lap the milk himself when held up to it, and vomited a pretty deal of it, which relieved him more; and then he lapped again, but could not stand on his legs. I left him in this condition about seven o'clock, thinking he would have recovered, and left orders that he should have a pan of milk, and another of water, about a pint of each, set by him, and that he should be kept shut up all night. About eleven o'clock he was seen walking about; but next morning he was found dead, after having drank up all the milk and water, and having vomited and purged pretty much.

Thus we find this simple water equally mortal with the bite of the rattle-snake, and more quick in its operation than any mineral poison; and tho' it may not immediately bring on death when taken in small quantities or mixed with other liquors, it being common a-
mong

mong our good housewives to put laurel-leaves into cream to give it the rattafia or apricot-kernel flavour; and among some compounders of cordial waters to use the berries of this plant in brandy instead of black cherries, or to mix some of the distilled poisonous water with brandy to make rattafia, or to dilute it with common water till it resembles black-cherry water in taste; yet an habitual use of these liquors must certainly be exceeding prejudicial and unwholesome. I am informed that a gentleman and his wife, who used for several years to drink daily a dram or two of the brandy in which laurel berries were infused, both died paralytic, having lost their speech some time before.

*Observations
upon Dr. Ea-
ton's styptic.
By Dr. Spre-
ngell. n. 383.
p. 108. May
C. 1724.*

IV. **T**HAT fresh wounds may be cured in a few days, without suppuration, where neither nerves, large vessels, bones, nor any of the viscera were concerned, has been long known. Purman, a famous surgeon of Breslaw, in his *Chirurgia curiosa* tells us of a mountebank, who gave himself thirteen wounds by incision in the upper part of his left arm, and thereupon applied his nostrum which with the help of a good roller cured him in two days time. Next he mentions a martial styptic, which stopped bleeding incomparably and healed fresh wounds (as he says) in two days, especially if the patient took withall a few drops inwardly. This was likewise mentioned by Blegny near thirty years ago. When I was in France I saw many little trials made there also with a styptic ball mixed with French brandy, by striking a cock through the head, opening the crural-artery of a dog, or chopping off a dog's leg, &c. but I found that it did not amount to any thing of consequence; yet I have still a ball made above twenty years ago of filings of iron and an equal quantity of tartar mixed well with French brandy upon a marble. This, with some alteration, was afterwards published by the famous Helvetius†, Physician to Lewis XIV. of France, and in 1710. the preparation was sold by Pierre Rottermond apothecary at the Hague, whose recipe is as follows: take four pounds of the filings of steel and eight pounds of tartar well powdered; mix them well together, put them into a new earthen pot, and pour on as much French brandy as will make them into a poultis. Let this stand fermenting in a cellar for four days, and stir it between whiles. Then put it in baln. mar. and distil it s. a. with a moderate fire, to draw off the brandy. When you find that nothing but the phlegm comes over take out the mass, and stamp it very fine that not the least lump may remain; then mix it again with a sufficient quantity of brandy, put it in the cellar to ferment, and distil it, as before. This operation may be reiterated seven or eight times; but the last time mix your mass well upon a marble and form it into two ounce-balls. For use

† Recueil des methodes pour la guerison des diverses maladies.

one of these balls is hung by a wire in a pint of good French brandy a little warmed, till the brandy has received the colour of the ball; but if you are in haste grate a sufficient quantity of the ball into some brandy, stir it well, and you may use it that very instant. No doubt but the author thought by often grinding, fermenting, and distilling this mass to comminute and subtilize its particles, so as to make it more fit to contract the fibres and vessels of a wound, and to prevent stagnations of the fluids both within and without upon contusions; but the success did not answer and therefore it was laid aside. Neither did Helvetius ever recommend it as an universal styptic, astringent, or consolidating medicine, but meerly in fresh wounds, and that only for a first dressing, and where people lived at a distance, and could not get immediate assistance from a surgeon. Besides, he makes several exceptions where it should not be used; and, in general, advises it where chalybeat medicines may be given according to experience. But last year a balsamic styptic was published by one Dr. Eaton, good to stop all manner of bleeding without or within, and that without any exceptions. This made me desirous to see it, and having soon after an opportunity of examining it, I found presently that it was the same old medicine, which was got hither after other countries had discarded it. I therefore neglected it as not worth my notice, till I saw lately a treatise of consumptions, published by Sir R. Blackmore, giving it the greatest encomium that ever was given to any invention whatsoever. For, says he, "Dr. Eaton's balsamic styptic bids fair for the credit of a certain remedy in stopping of blood outwardly or inwardly, where the crasis of the blood is not entirely ruined; and will be of more service to mankind, than all the discoveries made by Galenical-compounders of drugs, and systematical methodists." Finding it recommended in so extraordinary a manner, and by so eminent a physician, I began to think that possibly I might have been mistaken, and therefore desired an apothecary immediately to prepare the recipe as described by Helvetius. When it was ready I sent for a bottle of Dr. Eaton's styptic and tryed them both with galls; the tincture was the same, a deep purple. I then precipitated the contents with old hoc, and found the precipitated matter to be the same in both. Not contented with this, I sent several small quantities to others, and went myself to Mr. Godfrey. They all told me there was no difference betwixt them. I tryed several ways to find out the balsamic quality, from whence it has its name, but found none. Then, I confess, it surprized me that a man who had a mind to vend a thing as a secret, had not so much as altered it either in taste, smell or colour, tho' it might very easily have been done, without robbing it of its virtue in the least.

I next tryed them both upon the crural-artery. Having got a good middle-sized dog, Mr. Ranby laid the artery bare, and opened it

it with a lancet lengthways for near half an inch. The old trick used to be to cut the artery crossways, and then there was no necessity of a styptic at all, nor indeed here neither. At first Helvetius his tincture was applied and stopped the bleeding; then we opened the artery again and tried Dr. Eaton's with the same success. I then laid the artery open in the other thigh, and tryed it only with French brandy, which I found did as well as the other two. I opened the artery again, and applied a little sal martis and saccharum saturni dissolved in French brandy, which answered in the same manner. This made me immediately conjecture that there was but little virtue in either of them; except that the brandy, by its great heat, did merely contract the fibres of the artery, which, no doubt, might be a little assisted by the chalybs; but this could not be much. I then reflected upon the smallness of the crural artery in a dog compared to the crural artery of a man, and believing that a little pledget of lint might stop the blood there as well as in the temporal artery when opened with a lancet we tried it and it succeeded. We then untied the dog and let him go; he ran directly home, where his mistress not knowing what had been done to him tore off the pledgets, and had him well washed with butter and beer warmed; upon which the dog fell a bleeding again, tho' not much, and the blood stopped of itself. Thus far as to its outward use, and I could wish it were as harmless within. If, according to Helvetius, it had been ordered inwardly only in fresh wounds and contusions, it might have been let pass; but when it was recommended in all inward bleedings without exception, I thought it high time to make some animadversions upon it. Sir Richard himself says †, that in spitting of blood there is an orgasm or stimulating ferment. What is this but a feverish indisposition? and is there any hæmorrhage without? If so, will not brandy and chalybeats heighten it? Do not they by their heat and stimuli brace and irritate the fibres, and accelerate the blood's motion? And will not the blood then take up more room, and press harder against the sides of the vessels and whatsoever opposes it? Is not this the way to make an orgasm and cause an hæmorrhage? Dr. Eaton tells us himself in his book, p. 57. that it did very much overheat a gentlewoman, that her bleeding still continued after the taking of it, and she might have perished if a surgeon had not given her a cooling and astringent apozeme. And but just before, p. 47. he complains of a physician, who was not willing that his patient should take it when she had a hectic fever upon her, because he was afraid it was too hot.

Since the former trials I desired Mr. Ranby to open the carotid artery of a dog, thinking that might give me more satisfaction than the crural arteries had done. Having laid bare the jugular vein,

† Treatise of Consumptions, p. 99. & 101.

divided and tied it that its bleeding might not hinder us from finding the carotid artery, we were obliged to cut some of the muscles thro' likewise, till with some difficulty we found the artery; which being opened with a lancet and the blood spouting forth, I applied to it Helvetius's tincture, upon which the blood stopped. I took it off in less than a minute, and made it bleed again, but it bled very little, and then I applied Dr. Eaton's styptic; we filled up the wound with lint, and stitched up the cutis, untied the dog and let him run down stairs; after some time I found him again, and perceived he had bled a good deal and was still bleeding. I was very well satisfied that the artery being so very small he would not bleed to death, and if he had had nothing but lint upon it it would have done as well. It must be observed that the carotid arteries are largest in proportion in human bodies, and that this artery of the dog was but a small matter bigger than the crural arteries of the former dog. This shews that the styptic quality of these tinctures is very inconsiderable; and that Helvetius's is rather better than Dr. Eaton's, if there is any difference at all, more than might be owing to the brandy, for mine was stronger than Dr. Eaton's. I enquired for the dog next morning and found him alive and well, only hanging his head on one side, which proceeded from the muscles being cut through.

V. **I**N conversation t'other day I told you how successfully I had used camphire in maniac disorders, and that hitherto it never failed my expectation in these and other cases wherein the genus nervosum and blood seem to be affected after the same manner, but in a less degree. At your request I send you the history of four cases with all the exactness my memory is capable of. I own I flatter myself that from the effects of this medicine physicians may be led into a more sure way of reasoning in nervous disorders.

The efficacy of camphire in maniacal disorders. By Dr. D. Kinneir to Dr. Campbell. n. 400. p. 347. OZ. Sc. 1727.

1. A gentlewoman of nineteen years of age from an obstinate fasting for two days, and an aversion to see company in a religious turn before Easter, fell into a deep melancholy, would not talk, nor answer any question for some time, but moaned and sighed continually, slept very little for ten days. This happened in the wane of the moon. The night before the change she spoke and called for some water to drink, which being given her she immediately fell a starting and laughing, and her eyes had a briskness in them somewhat uncommon, as her relations told me, then began to talk wildly and continued so all that night. She became next morning very furious; whereupon a physician was called, who bled her four times a week the first fourteen days, vomited her, purged her, used the cold bath, and many other methods common in such cases, all to no purpose. In this condition she continued for nine months; then I was applied to. I first began her with an antinomial vomit, which had no other effect than that of setting her fast asleep for twelve hours. Next day I gave her half a dram of camphire in a bolus, and as much at night.

She continued to rest well all that night, and had a great moistness over her whole body, and in the day-time a plentiful discharge by urine. Thus for four days I plied her, and afterwards in the day-time I ordered her pills of æthiops, gum guaiac. cinnab. antim. & pulv. de gutteta; and at night the dose of camphire. She altered sensibly every day for the better, and in three weeks time enjoyed the full use of her reason, and though nine years ago, is at this time in a very good state of health, having had no extraordinary ailing ever since.

2. A gentleman of a good family, aged seventeen years, from some disappointment became very silly and stupid. He continued in that way for a long time, notwithstanding he had the best advice. He had a great inclination to chaw and eat every thing that came in his way, be it what it would. He rested pretty well a-nights, and was delighted with the sight of every glaring object. He hid every thing he could lay his hands on, as well in company as alone, and was no ways ill-natured. Thus for half a year he continued, but then became so furious that two men could hardly hold him from beating every body that came about him. Thus he would continue for three or four days together without sleeping; then he would become calmer after having slept some time; but was a little mischievous. This was the way from new moon till the full; after which he became silly and melancholy, speaking little, and looking always down, not caring to look one in the face. So it was alternately for fourteen months. When I came to him I found him full of complaints of his ill treatment; and had not I had a watchful eye upon him I had suffered by a blow aimed at me; but I got him to take the medicines as before, and with allowing him a more plentiful diet, and a great quantity of diluting drinks, he became perfectly well in six weeks, and has enjoyed a good state of health and sound judgment these several years, and is now in business.

3. A mercer's wife of thirty-six years of age, who had born four children, and was naturally of a lively, active disposition, fell so ill all of a sudden one day at church, that with much ado they could get her out with common decency. She tore every thing about her, talked much, and uttered horrid oaths. In short, she was as much disordered as you can imagine any one. She had the advice of the best physicians in Edinburgh, but they failed of success and left off visiting her. About half a year thereafter I was consulted. I treated her in the foregoing manner, and in four days there was a sensible alteration for the better, and in four more she went abroad. I still continued the use of the medicines for fourteen days after recovery, and now she is as well as ever she was in her life.

4. A young man aged twenty, of a full habit, was so very bad in the sullen, despairing way, wounding himself with his teeth and hands, that there was a necessity of watching him closely. I vomited

him

him twice, gave him some other things common in such cases, and then exhibited the camphire, which in ten days brought him to reason. He relapsed after that on the change of the moon, was ill for three days, but not so as before. He came out of it again, and stood the change of the next moon with only a little heaviness as in the hypo. About the full of the same moon he was very uneasy, and seemed to resemble a person greatly hypochondriac. I still continued to him the camphire and the other alterative medicines for some time, but in a much smaller dose than what I gave him in his illness: so in nine weeks he was perfectly cured and continues in good health.

This, Sir, is the substance of what I remember of the preceding cases, wherein I layed the whole stress of the cure on camphire.

VI. I. **C**UM jam plures, quorum aliqui ipsas quoque Indias peragrarunt, de camphora tam copiose scripserint, ut nihil eorum quæ ad integram historiam camphoræ dilucidandam pertinere videri poterant intermiserint, siquidem & originem vocis explicarunt, & synonyma cuncta collegerunt, arborem unde petitur camphora, & loca in quibus arbores hujusmodi proveniunt indagarunt, modum quo camphora ibi colligitur & in Europa depuratur, denique & usus in quos adhiberi potest docuerunt; supervacaneum plane foret ista omnia hic repetere, chartasque meris citatis complere. Cuivis etiam suam de camphora opinionem & sententiam liberam esse volo, sive eam pro succo nativo, sive pro gummi, pro resina, sale volatili, bitumine, sive pro succini specie, sive pro quocunque quivis eam reputet. Etenim nihil jam aliud in propositis habeo quam peculiarem quandam observationem recensere &, quid de ea sentiam explicare, denique novas quasdam ex tali meo judicio deductas doctrinas communicare; sperans fore ut alii veriore exinde sententiam de camphora, quid ea proprie sit, dicant, alii vero occasionem capiant in rem institutis de super experimentis convenientibus inquirere, eamque dilucidare.

*Of camphire.
By Mr. Casp.
Neuman.
n. 389. p. 321.
July 1725.*

Traditum est in scriptis de camphora editis posse etiam præter ordinariam, quam copiosam satis habere possumus, aliam ex radice cinnamomi, zedoaria Ceylonica, roremarino camphorato, abrotano aliisque vegetabilibus aromaticis parari, quod certo respectu negari nequit & hac ipsa observatione mea confirmatur; nihilo tamen minus confiteri me oportet ante omnia me nusquam locorum quæ peregrinando adivi talem ex aliis & jam dictis vegetabilibus paratam, licet diligenter perquisitam, ne in minima quidem quantitate vidisse camphoram, quæ in solida & vere sicca consistentia cum orientali conveniret; sed quicquid hujusmodi mihi monstratum est Amstelodami fuit illud oleum quod in India ex radice cinnamomi destillatum dicitur & camphoram non minus quam cinnamomum redolet; quamvis dubius adhuc hæreo genuinum ne illud destillatum fuerit, an oleum cinnamomi ordinarium copiosa camphora imprægnatum? Si quidem multa experientia comprobatum habeo solere vulgo & imprimis in loco jam dicto varias merces, potissimum ad rem

medicam pertinentes, fucō inducto effingi & per miscelam adulterari: sed quoquo modo se res cum isto oleo habeat, posito etiam nihil fuci subfuisse, & ostendi posse camphoram, etiam in solida consistentia, ex radice & ex zedoaria Ceylonica aliisque orientalibus vegetabilibus elicitam, nemo tamen, quoad scio, solidum quid camphoræ æmulum ex vegetabilibus Europæis unquam produxit; licet de roremarino multi multa dixerint, & de aliis quoque plantis nostratibus conjectura præsumferint; imo licet etiam Dn. Hofmannus professor Hallensis celebr. & eques Angl. Boyle memoriæ prodiderint, quod ille † simile quid ex floribus rosarum & ligno aloes hic ‡ vero ex oleo anisi impetraverit; penitus tamen ego sum persuasus quicquid camphoræ simile ex his tribus productum fuerit molle quid & unctuosum, vel ad summum butyraceæ consistentiæ, minime vero siccum, crystallinum, fragile & camphoræ duritiæ æmulum fuisse; id quod etiam ex ipsorum descriptionibus quivis facile potest colligere. Taceo, quod in vulgus notum est, oleum anisi in frigore butyri instar condensari, minime vero in camphoram eo ipso abire. Præter hæc quæ in scriptis commemorata legimus fuerunt aliqui, & in his quidam pharmacopœus, cæteroquin rerum suarum satagens, qui ore tenus mihi affirmarunt posse se ex variis plantis indigenis camphoram parare, cujus modi tamen ne tantillum quidem unquam videre licuit; interim assentior & lubens credo potuisse hos eadem facilitate qua ego meam impetrare camphoram.

Placuit igitur ad inclytam regiæ societatem referre acquisivisse me ex nostrati thymo vulgari verum, densum, crystalliformem & in omnibus qualitatibus conspirantem, nec nisi odore differentem camphoram, quæ cuncta experimenta huc usque cognita, & pro justo examine excogitata possibilia æque ac orientalis sustinet, atque ita cum hoc in omnibus, solo odore excepto, convenit. Destillaveram anno MDCCXIX. ex dicta herba olei copiam bene multam, institutaque hujus ab aqua separatione cum gossypio, cernebam tam ad orificium vitri quam in gossypio oleo imbuto parvos figuratos crystallulos hærentes, qui ipsam destillationem alias satis celerem magis magisque remorabantur, adeo ut necessarium esset gossypium contra morem aliquoties renovare. Mirabar quid rei novæ & extraordinariæ contigerit, variasque cogitationes agitabam, parum tamen vel nihil certi ea de re unde eveniret, & quid esset, poteram colligere; lagenam igitur oleo plenam & bene munitam reposui. Interim semel excitatæ & conceptæ de rei novitate cogitationes inquietum me tenebant; quare sciendi cupiditate ductus, post paucos dies resumo lagenam olei, visurus an denuo crystallini quid ad orificium vitri hæreat, & quantulumcunque demum id fuerit per experimenta tamen parvula probaturus cujus indolis illud sit; sed circa orificium nihil ejusmodi reperiēbam, circa fundum vitri vero, quod me tanto magis attentum,

† Vid. ejus Dissertat. de Camphora & Observat. Physico-Chym.

‡ Vid. ejus Tr. de Firmitate & Fluiditate.

ne dicam attonitum habuit, confedisse vidi cryсталlos in fatis magna quantitate, diversæ magnitudinis, partim avellanas exæquantes, plerasque cubiformes, saccharo cande similes. Nondum suspicabar camphoram, sed potius sal volatile, quod pro copia herbæ successive simul transcenderit, & in parte aquosa solutum, postquam hæc fundum petiisset purumque oleum supernataret, tandem ita coaluerit. Effundo igitur oleum ut sal, quod esse putabam, impetrarem & iudicii mei certior fierem. Sed denuo in admirationem raptus sum ubi ne guttulam quidem aquæ in fundo inveni, nec consultius quicquam erat quam magma salinum a fundo liberare & ab oleo separatum fervare. Quo me igitur ex dubio extricarem, vel potius ut de sale, quod iudicando præsumseram, certior essem, tentavi experimentum quo cuncta salia, cujuscunque indolis & nominis fuerint, probantur. Magnam scilicet quantitatem aquæ destillatæ infudi super materiam cryсталlinam, sat diu simul agitavi, hinc per aliquot horas quieti dedi, solutionem cryсталlini per omnes horæ quadrantes cupide sed frustra expectans; neque enim solutionem neque ullam mutationem ejus animadvertēbam, præter quam quod minimæ particulæ in superficie elevarentur, majores vero quantumvis bene interagitatæ fundum semper repeterent, & aqua particulis oleosis a cryсталlina materia cui adhæserant agitatione liberatis imprægnata esset. Transfudi aquam, & nova adfusa denuo tentavi cryсталlorum pro indole salium solutionem, postquam ab adhærente oleo, quod forsan solutionem eorum in aqua impediret, liberati essent, sed pertinaciter solutioni renitebantur, quam neque adhuc dum, sæpius licet tentatam, admiserunt. Dehinc, præoccupatione de salino concremento plane abjecta, conjectari cœpi quod plane quid aliud, scilicet mixtum oleosum, vel quasi resinofum volatile ex oleo condensatum esse debeat. Hoc mecum perpendens sub examen revoco varia, vere existentia mihi que nota subiecta, si quid eorum cum novo hoc comparari queat, & mox ob similitudinem cogitavi de camphora. Sine mora igitur nova quædam, per quæ me magis certum de re fore sperabam, adornavi, & omnia quæ feci experimenta non alia quam quæ communis camphora suppeditat phænomena exhibuerunt; unde tandem, utpote veritatis convictum nullo plane dubio relicto, concludere me oportuit corpus hoc cryсталliforme aliud nihil quam veram esse camphoram, quæ ab orientali non nisi in eo differat, quod hæc thymum, illa vero aliud vegetabile redoleat, quod quia camphoram copiosam suppeditat huc usque nullo alio quam arboris camphoriferæ nomine indigitatum fuit. Ex his omnibus sequentia mihi concepi dogmata, quæ ulteriori cujuscunque indagationi propono.

I. Nomen camphora vel caphura non speciale seu proprium est quod uni soli ex India venienti camphoræ semper competat, sed pro generali seu appellativo potius haberi debet (uti v. g. nomen salis, olei, aquæ, spiritus, &c.) ita ut pro distinctione speciei camphoræ nomen illius vegetabilis addatur ex quo parata est, sicuti mea camphora jure meritoque camphora thymi dicenda venit.

II. Sub

II. Sub hoc nomine camphora concepta cessat omnis controversia inter autores hactenus agitata de specie ad quam camphora pertineat; si quidem neque resinis, neque salibus volatilibus, neque oleis & succis accensenda est, multo minus ad gummi vel bitumina referenda, quod cum his omnibus per omnia non conveniat, sed jam in hac, jam in alia qualitate, jam plus, jam minus præcipui, vel tamen plane diversi quid habeat. 1. Resina dici nequit, quia, quod etiam jam Hofmannus adnotavit, (a) Omnes resinæ post combustionem cineres, vel aliud terrei aliquid relinquunt; camphora e contra plane nihil, sed tota deflagrat & in auras avolat. (b) Nullæ resinæ in vase clauso penitus & in totum elewantur ab igne seu sublimantur; quod tamen cum camphora succedit. (c) Resinæ ubi destillantur, phlegma præbent & oleum, partim etiam spiritum sic dictum; camphora vero horum nihil. (d) Nulla plane resina est quæ ad instar camphoræ in spiritu nitri solvi queat. (e) Nec ulla datur quæ æque cito & in tanta copia in spiritu vini colliquescat; neque (f) Talis quæ in aqua calida camphoræ instar avolet. 2. Multo minus camphora sal volatile dici potest, quia in aqua non solvitur, nec cum aqua intime, quin videri possit, miscetur; quam tamen solutionem invisibilem cuncta falsa admittere debent necessario, uti supra jam commemoratum est. 3. Quamvis autem camphora oleosum mixtum vel ex oleo condensatum corpus sit, ideo tamen simpliciter oleum vocari nequit, æque ac alia mixta solida oleo prægnantia, siquidem olei nomen liquidis præcipue, vel ad summum tenuiter unguinosi, minime vero solidis & siccis subjectis tribuitur & convenit; neque ullum oleum in sicca substantia, ceu camphora, sublimari potest. 4. Succus nomen camphoræ non convenit, quia succi proprie dicti mixtionem. (a) Vel gummosam, quæ in aqua facile totaliter liquefeit, (b) Vel gummi resinofam, quæ partim in aquoso, partim in oleoso, inflammabili, spirituoso & simili solvitur, (c) Vel resinofam obtinuerunt, qui posteriores resinæ propriæ dicuntur, de quibus sub numero 1. dictum est, quarum proprietatum nulla camphoræ convenit. Nam si omnia ea, quæ ex arboribus aliisque vegetabilibus partim sponte proveniunt, vel a natura & sole, partim etiam per artem parantur, quamvis in tota planta ejusque succo & partibus aliis dispersa & commixta fuerint, succos vocare quis vellet, quantam non confusionem ineptam & conceptu impossibilem pareret in describendis rerum essentiis? Sic enim omnis aquæ, succi, gummi, olei, balsami, resinæ similiumque diversitas plane periret, verbaque hæc distinctiva nullius plane usus forent. 5. Camphoram etiam gummi vel bitumen non esse ex prioribus jam satis apparet; quicquid enim gummi vocatur, penitus in aqua colliquescit, sicuti bitumina maximam partem in ea solvuntur, ambo vero sublimationi refragantur, quam camphora tamen admittit. Cum igitur nihil in orbe terrarum cognitum sit quod cum camphora comparari possit, æquum etiam est ut suo quoque nomine singulari & specifico insigniatur, per quod si res quædam dicatur camphora

camphora statim intelligatur eam neque oleum, neque gummi, sal volatile, resinam, spiritum, neque bitumen, sed plane aliam & a dictis his diversam esse materiam, mixtum nempe ex ingredientibus camphoram veram constituentibus concinnatum, indolis specialissimæ. Unde quæstio an sal, vel gummi, resina, vel succus sit, æque inconueniens & supervacanea judicabitur ac si quis quærere velit an sal sit oleum, vel an gummi sit camphora.

III. Ex prioribus deduco quod omnis camphora certum suum specificum odorem, & quidem oleum illius plantæ ex qua parata est constanter retineat, quodque odor iste sine destructione totius camphoræ separari ab ea nequeat.

IV. Consequitur quod experimentum nostrum de camphora thymi orientalem camphoræ fabricationem satis superque confirmet, nempe quod destillando paretur & acquiratur; in quo negotio vix alia intercedit diversitas quam quod ex sic dicta arbore camphorifera ibidem in magna copia & ita longe plus camphoræ quam olei haberi queat; cum e contrario vegetabilia Europæorum plurimum olei parum vero camphoræ largiantur.

V. Hinc certo credere possumus, alias quoque plantas Europæas, copioso oleo essentiali prægnantes, æque ac thymum camphoram daturas esse, quamvis nullam adhuc viderim, neque pro ea elaboranda justam occasionem nactus fuerim vel otio abundarim.

VI. Si qui sint qui plane singularem vel peculiarem camphoræ indolem distincte nequeant concipere, & ex quibus denique constet scire velint, in horum gratiam pro mea quidem qualicunque experientia amice mentem meam declarabo; quod camphora sit siccum quid, album, pellucidum & fragile, valde acute olens, non solum in igne sed etiam in aere subcalido prorsus volatile corpus, quod ratione mixtionis, ex copia principii inflammabilis rarefacti, pauca aquositate, & summe attenuata vel subtilissima terra, inter se unitis constet. 1. Constat camphora rarefacto phlogisto, quia non solum cito & tenuiter, imo etiam in aqua & nive ardet, sed etiam cum aliis de eodem principio copiose participantibus celerrime unitur, ex quibus spiritus vini commemoratione, nitri vero spiritus meditatione dignissimus est, siquidem de posteriore paucissima sunt cognita. 2. Aquosi aliquid continet camphora, cum alias principium inflammabile, licet copiosius, flammam exhibere non posset. 3. Terram subtilem nemo negabit, quia extra hanc siccum corpus crystallinum non sisteret. 4. Nec in dubium vocabitur terram hanc subtilissimam, cum cæteris intime, perque minimas quas vel cogitando concipere possumus partes unitam esse, si perpendimus quod camphora in solo aere, aliquantulum tamen subcalido, in tota mixtura sua plane nihil post se relinquens, avolet.

Definitio hæc per ea ipsa, quæ hætenus de camphora thymi diximus confirmatur, considerando quod ea solummodo ex subtili oleo essentiali ortum duxerit, in quo oleo non alia quam superius dicta tria constituentia, phlogiston, aqua & terra demonstrari possunt, quamvis

quamvis sub notabili hoc discrimine, quod 1. Camphoræ mixtura multo subtilior quam olei, quinimo (si ita loqui liceat) quinta essentia & extractum olei sit. 2. Camphora parum saltem aquei principii in sui mixturam recepit, oleum vero intuitu hujus longe plus. 3. Terra camphoræ summe attenuata & adeo subtilis est ut sponte simul cum cæteris constitutivis avolet in auras, cum contra terra olei multo sit crassior; id quod etiam, ut alia taceam, in rectificatione vel exhalatione olei videre est, ubi primo resinæ vel bituminis instar, tandem etiam crassiori specie apparet.

Quod superest, dissimulare non possum hæc aliaque experimenta de camphora facta dubium me habere an etiam ullo alio quam destillationis modo camphora acquiratur. Præ cæteris de veritate suspecta mihi videntur quæ de collectione camphoræ in insula Borneo asseruntur; dicunt vero quod ibi locorum sponte camphora instar gummi vel resinæ ex arbore exsudat, atque ita ab incolis colligatur, multo pretiosior quam Japonica, quæque præ raritate tam cara habeatur ut incolæ illius insulæ nihil ejus concedant exteris. Sed quoquo modo res cum hac traditione sese habeat justas tamen de ea dubitandi causas habeo, & in his potissimum camphoræ volatilitatem naturæ ejus penitus insitam; namque si ex arboribus exsudaret non adeo diu sub sole fervidiore quo terræ illius climatis incalescunt persisteret, sed sat cito in aere libere exhalando fugeret; idque tanto facilius quia cum exsudaret multo liquidior esse deberet nec consistentiam camphoræ duriorem habere posset, quæ vero liquiditas ad tanto celeriore exhalationem disponderet, si quidem per se camphora in molli vel liquida consistentia retineri plane non potest cum accepto calore, & ubi colliquescit mox avolat; qua de causa etiam cum resina comparari nequit. Quod vero camphora nativa, ad instar destillatæ, in oleo suo destillato quasi soluta ex arbore profluat, & dein ad arboris corticem crystallorum in modum concreascit, tanto minus credo, quum pauca vel nulla potius exempla comperta sint ubi natura olea destillata essentialia aliaque arte facta, instrumentis debitis quippe destituta, produxerit. Et parum abest quin credam totam traditionem de tali collectione camphoræ non nisi ex auditu commemorari, & viros cæteroquin eruditos Ten Rheine, Breynium, Hermannum cæterosque, alium ex alio transcripsisse, nullum vero, quantum credere par est, rem oculis in arbore ipsa conspexisse, quæ quidem fallacia in historia naturali prima non foret. Hinc denique concludo esse omnino hanc speciem camphoræ tam raram ut eam oculis cernere nemini liceat, nec forsan unquam contingere queat.

Of the same.

By Mr. J.

Brown. n. 390.

p. 361. Sept.

&c. 1725.

VI. 2. **I**N tractatu nuper à D. Neuman, Germano, in Angliam missò, cui titulus de camphora, inter alia vir doctus hæc habet. “Acquisivi ex nostrati thymo vulgari verum, densum, “crystalliformem, & in omnibus qualitatibus conspirantem, nec “nisi odore differentem camphoram; quæ cuncta experimenta “huc usque cognita, & pro justo examine excogitata possibilia

“æque

“æque ac orientalis sustinet, atque ita cum hoc in omnibus, “solo odore excepto, convenit.” Quibus verbis paulo post subiungit, “se hanc camphoram ex oleo thymi destillato obtinuisse.” Hæc ille: de quibus non inutile erit pauca observare. Primo mihi animum subit quoddam apud nos esse eodem modo è nostrati thymo destillatum, quod hætenus improprio salis thymi volatilis nomine dictum fuit: non tamen video quomodo camphora thymi verius dici possit. Equidem non in dubium voco quod ex propria experientia affirmavit vir doctus de eo, quicquid demum sit, quod è thymo extrahit quodque appellat camphoram: liceat tamen mihi, pace viri eruditi, paucis notare differentias quas ipse observavi inter camphoram proprie dictam & illud quod è thymo apud nos destillatum habemus. Præparatio nostra est hujusmodi: oleum thymi coagulatum seu condensatum, pellucidum, crysalli formâ indutum, varix magnitudinis, varixque figuræ, post primam separationem saccharo cando albo, mox vero rubro, simile; valde thymum spirans, pungentis vel etiam caustici saporis, non fragile ut camphora. Hoc in quibusdam experimentis à vulgari camphorâ, qualis in officinis venditur, non multum differre fateor. Eadem specifica gravitate videntur esse. Neutrum horum in aquâ solvi potest. In spiritu vini ambo facile solvuntur. In aliis vero phænomena adeo sunt diversa ut mea sententia nomen camphoræ utrique competere non possit. (1.) Camphorâ in spiritu vini solutâ & postea in aquam projectâ, subito coagulum album supernatat, quod reverâ apparet esse camphora, odore, sapore, & substantiâ. Quod si eadem in oleo nostro coagulato experiri velis, videbis in aquæ superficie guttas parvas olei liquidi innatare, quæ sensim in crysallios planos (crysallis lunæ non multum absimiles) formantur, etiamque saporem & odorem thymi retinent. Diversitas adhuc magis è sequenti experimento comparuit. Utramque mixturam supradictam tota nocte in aere frigido exposui: mane coagulum, quod prius camphoræ in spiritu vini solutæ innatasse dixi, prorsus evanuerat, aquâ camphoræ odorem adhuc retinentè; fortè propter spiritum vini admixtum: in altero vero, nempe oleo thymi coagulato, crysalli aquam supernatantes in eodem statu quo antea fuerant remanebant, nec quicquam erant diminuti. (2.) Camphoram solidam per vim spiritus nitri in liquorem pellucidum mutatum iri quis in re chymicâ vel minime versatus non novit? At oleum nostrum coagulatum, si eidem menstruo adjiciatur, pristinam quidem formam crysallinam penitus amittit & substantiæ resinosæ seu gummosæ formam induit, nec unquam in fluidum evadet, quantumvis vasculum in quo continetur validâ manu & sæpe concutias. Præterea si liquorem illum pellucidum in quem camphora redacta erat in aquam postea effundas redintegratur camphora: contra, oleo nostro coagulato eadem substantia resinosa seu gummosa adhuc manet, & sapor thymi adhæret cum notabili amaritudine adjecta. (3.) Oleum vitrioli (ut docuit noster Boyleus) camphoram in totum dissolvit: in

oleum vero thymi coagulatum, quod supra descripsimus, nullam aliam mutationem inducit, nisi quod vi manûs concutientis crystalli in minores partes dividantur; & hoc modo crystalli olei, si microscopio observentur, fragmentis camphoræ se magis assimilant. Insuper camphora oleo vitrioli soluta se ab hoc menstruo recuperat si postea in aquam fundatur: nostrum vero eandem formam crystallorum quam in oleo vitrioli habuit, etiamsi in aquam effundas, una cum sapore & odore thymi adhuc retinet. (4.) Scribit D. Neuman "camphoram constare rarefacto phlogisto"; at minime quidem nostrum: nam si igni admoveatur extemplò colliquescit & oleum fit liquidum. Si gossipium quidem immergas idque deinde igni admoveas flammam statim concipit: sed hoc gossipio deberi clarum est, idemque oleis omnibus commune. (5.) Ignis in duo ista corpora diversos effectus habet. Nam qualiscunque ignis gradus idoneus est ad sublimandam camphoram sine ulla liquefactione, idem corpus hoc è thymo destillatum & condensatum prorsus liquefaciet, & liquefactum tenebit cum nulla vel minimâ sublimatione.

Haftenus de differentiis. Quibus non abs re fuerit testimonia quædam de oleis coagulatis, seu salibus ex oleis natis, huc pertinentia subungere. Quidam ex nostris fociis, rei chymicæ admodum peritus, D. Slare, in philosophicis actis abhinc plusquam triginta annis editis oleum nostrum hisce verbis describit †, "Ex satis magnæ copię thymi destillatione separatum est sal volatile indolis singularis, (quod peritissimus noster chymicus D. Moulton primum mihi exhibuit) hoc est pellucidum, vel crystallinum, quoad gravitatem suam specificam paulo aqua ponderosius, idemque & sal & oleum in uno corpore coagulatum esse videtur: in aqua non solvitur, sed calefactum facile avolat." Idem vir doctus ‡ se oleum cinnamomi viginti annos asservasse dicit, & intra sex annos postremos singulis annis quoddam salis præcipitatum fuisse, & hoc sine ullo additamento aut arte ad salis formam inducendam. Sed quoad hujus salis naturam, an simile fuerit ei quod ex thymo destillatum ostendit D. Moulton, fileat. Helmontius de sale ex eodem oleo arte factò sic locutus est. "At quando oleum cinnamomi suo sali alkali miscetur, absque omni aqua, trium mensium artificiosa occultaque circulatione totum in salem volatilem commutatur;" etiamque in alio loco modum quo oleum cedri salis naturam assumat, vi menstrui sui alkahest, docet, additque hæc verba, "se se permiscebit aquæ." Cl. Boerhavius (si modo Chemiæ Institutiones ejus nomine nuper editæ genuinæ sunt) sic scribit, "Diu asservata olea pretiosissima aromatum orientalium, vasis bene clausis, mutantur in salem seu saponem; sed experimentum non facile imitari possumus; nam docente Hombergio demum fit post multos annos, & dicuntur tunc aquæ misceri." In alio loco cum D. Neuman consentire videtur Boerhavius. "Camphora est nil nisi oleum per destillationem concretum in glebam pellucidam; nam non est progenies solius arboris camphoræ, sed omnes plantæ aro-

† Vol. III.
P. I. C. IX.
§. XVIII. 3.

‡ Ibid.

“ maticæ camphoram sui generis producere possunt;” & paulo post, “ oleum quod in insula Ceilon & alibi ex semine cardamomi fit fere totum in camphoram mutatur, quod idem verum est de pluribus “ oleis ibi natis.” At vero ante sex vel quatuor dies olea varia in India destillata, qualia sunt oleum ex cortice caryophyll. & calam. aromat. & radicibus cassumun. & similia, perlustravi; atqui nullam in his materiam condensatam sive coagulata reperire potui, quamvis plusquam decem annis hic recondita fuerint. Neque dicere possum cum D. Geoffroy jun. † me unquam observasse crystallos ex ol. teberinth. vel majoranæ parietibus vasium in quibus asservata fuerant adhærentes, similes crystallis camphoræ; quamvis vasa multos annos his usibus applicata diligenter inspexerim. Quod ad hoc sal seu oleum coagulatum thymi attinet, idem aliis in hac urbe in re chymica versatis notum est; nam hujus parvam quantitatem (nisi quod colore sit candidiore) nostro similem vidi: at in nullis aliis oleis aliquid hujus generis me vidisse memini, nisi forte mihi persuadere liceat inesse hoc tempore in suis principiis (si ita dicam) in oleo macis à nobis ab hinc jam quindecim mensibus destillato, hac sc. methodo: Satis magnam quantitatem macis pro una operatione recepi totoque die destillavi; at minore olei quantitate elicitam quam expectabam, altero die, & etiam tertio, pro re nata, destillationem reiterare institui: quarto, quantum memini, die posteaquam oleum aquam supernatans separaveram visus est mihi alius liquor, cum aqua non permixtus, vasis separatorii fundum petiisse; hoc etiam educto, inveni esse oleum macis aqua ponderosius: ita ut ex eadem planta, eademque operatione, oleum dispari gravitate extraxerim. In superiore parte hujus olei aliquid crystallinæ formæ hodie fluctuare videtur; cujus generis sit sive camphora, sive non, tempus docebit.

Postquam differentias inter nostrum oleum thymi coagulatum & camphoram orientalem supra descripseram, D. J. Maud chymicus ostendit mihi oleum majoranæ coagulatum, quod nuper & inopinato in vase in quo oleum majoranæ quinque annos asservatum fuerat invenit. Hoc oleum coagulatum majoranæ etiam eadem experimenta cum oleo nostro thymi coagulato subire volui; quod & factum est, eaque multum inter se convenire reperiēbam, ita ut hoc nihilo magis quam nostrum nomen camphoræ mereri satis sciam.

VII. 1. **M**ixta illa jam consideranda ut plurimum salia alcalina, salia fixa, vel salia lixiviosa appellantur. 1. Salia lixiviosa audiunt, quia per elixationem acquiruntur. 2. Salia vero fixa dicuntur, quoniam maxima ignis vi nec volatilia redduntur, neque in sublime feruntur vel abiguntur. 3. Quid per alcali denominationem intelligatur non adeo ignota res est, nempe oppositum acidi, vel quod idem est, anticidum. Origo autem nominis hujus ab Arabico alcali derivatur; kali significat sal, & al præfigitur, quemadmodum in gallica lingua articulus definitus le, la; itaque al kali conjunctim le sel denotat. No-

Of fixed alkali salts. By Mr. Casp. Neuman. n. 392. p. 3. Jan. &c. 1726.

† Memoires de l'Academie Royale 1721.

tum insuper est quod & herba quædam reperiatur kali dicta, in locis maritimis crescens multoque sale scatens, à Lobelio etiam soda nuncupata, quæ si comburatur & elixetur ingentem salis copiam præbere solet, quod olim simpliciter sal adjecto Arabico nomine alcali appellatum fuit. Cumque hoc ipsum sal combustionem etiam aliarum herbarum & vegetabilium forte ansam dederit, & sales inde prolekti ejusdem fere indolis & naturæ reperti fuerint, credibile admodum est veteres modo dicti salis originale nomen ideo retinuisse, & hoc illudve æque alcali appellasse, tractu vero temporis, ad meliorem distinctionem, hoc vel illud cognomen adjectum forsitan fuisse; ita præter pure salia alcalia corpora etiam terrestria alcalia innotuere; prioribus, pro nostro nunc scopo nobis inservientibus, ad distinctionem terrestrium latinam denominationem salis adjecerunt, & hocce in aqua solubile mixtum sal alcali, vel in genere salia alcalia appellarunt, ne forte sola vox alcali æquivoca evaderet, vel ad significationem ambiguam inter salinum vel terrestre alcali occasionem præberet. In genere autem monendum sive solum salia alcalina, sive salia fixa solum vocentur, utrumque nomen sensum habere æquivocum: etenim primo habemus & salia alcalia volatilia, & secundo salia fixa quæ non pure alcalina, sed salia dicta neutra constituunt: quamobrem securius erit præparata ista nunc consideranda ambobus simul insignire nominibus, puta salia alcalina fixa eadem appellare. Ceterum nobis sufficit quod voce alcali oppositum acidi intelligatur, per nomen fixum vero aliquid quod constans in igne sit, & per maximam ignis torturam, ita per se, non penitus destrui vel auferri possit.

Originarium alcali hodie quidem adhuc conficitur, sed non ex unica herba kali vel soda tantum, sed ex aliis simul ad maris littora crescentibus nec sale destitutis herbis. Cum vero maximam partem salis hujus soda vel kali forsitan porrigat, ideo sub nomine sodæ, & quum copiosissime in Hispania alitur & præparatur, sub cognomine sodæ Hispanicæ venditur. Quemadmodum vero kali hocce non parum de sale marino participat, cum quo, uti dictum, & aliæ herbæ permiscuntur, totaque incineratio & subsequens præparatio solummodo ab hominibus plebeiis ejusmodi locorum accolis peragitur; ita alkali hocce vel soda minime purum chymicum, sed aliis salibus & impuritatibus ut & abundanti terra conspurcatum sal alkali exhibet: quare nec chymicæ, neque medicinæ, sed solummodo mechanicis artificibus & opificibus, maxime vitriariis, saponum confectoribus & tinctoribus inservit. Si quis vero illo ad chymicos labores uti velit, tunc depuratione & separatione eorum quæ ad sal alkali purum haud pertinent omnino opus est. Hæc paucis præmittere volui, ad proprium scopum nunc reversurus.

The marks and properties of pure fixed alkali salts.

Sal alkali fixum purum primo quatuor proprietates alkali cujusdam in genere possideat necesse est, quibus & salia alcalino-volatilia stipata sunt. 1. Ut cum acidis quibuscumque effervescat. 2. Ut cum acidis hisce in sal medium abeat. 3. Ut omnes cum acidis factas solutiones præcipitet.

cipitet. 4. Ut cæruleum syrupi violarum colorem in viridem transmutet.

Sal alcali fixum contra in subsequenter proprietatibus a volatilibus alcalicis salibus quam maxime discrepat; nempe quod 1. Solutionem mercurii sublimati non in album, quod salis alcali volatilis indoles est, sed in fuscum, citrinum colorem præcipitet. 2. Cum cupro adjecto nec vestigium coloris cærulei excitet. 3. Cum spiritu nitri fumum haud producat. 4. Aquæ admixtum, non frigoris, sed potius caloris sensum illi conciliet. 5. Ab aere admissio haud siccum relinquatur, sed humidum evadat, vel denique lique scat. 6. In igne non avolet, sed permaneat, candescendo suaviter igne fere nihil, ingenti vero & fusorio, parum admodum de pondere suo amittat. 7. Non solum in igne fixum perseveret, sed etiam cito se fundi patiat, & denique 8. In crystallos haud abeat quemadmodum salia nonnulla volatilia.

Præterea sal alcali fixum purum etiam subsequenter qualitates peculiaris possidere debet. 1. Ut in forma soluta cum alio, circa quod occupati sumus, purissimo sale alcali fixo, absque ulla alteratione, turbatione vel præcipitatione, amicabiliter coeat necesse est. 2. Ut sulphur in humida via æque ac sicca omnino solvat oportet. 3. Cum acido vitriolico puro permixtum, & in sal medium crystallinum coactum, in igne nihil ponderis sui amittere nec ullo modo fluere debet. 4. Denique purum & genuinum ejusmodi sal alcali fixum, præter reliquas omnes antea recensitas 15 proprietates, cum pinguibus etiam vel expressis oleis saponem constituere necessum habet.

Quod si vero in unico solum harum proprietatum peccet, tunc statim signum penitus infallibile est sal alcali fixum non purum fuisse.

Quantum mihi innotuit natura nullum nobis satis purum, separatim, & cum recensitis proprietatibus dotatum sal alcali fixum porrigit, sed existit, si demonstrabile aliquod reperitur, (qualecunque in toto orbe sal alcali nativum invenire & explicare possum) unice & solum in illo, cum sale acido jam permixto, communi vel marino sale. 1. Quia illud nunquam nulloque modo in statu suo pure alcalino, sed ubique, sive cum acido salis communis, vel etiam, quemadmodum in fontibus nonnullis foteris, cum acido vitriolico conspurcatum reperitur; si denique illud demonstrare cupio (posito me hoc demonstraturum) variis nihilominus artificiis ab admixtis ejusmodi rebus liberari prius debet; ita ut talia artificiosis laboribus educta corpora haud simpliciter pro pure nativis, circa quæ ars minime versatur, declarare possim. 2. Quod hocce in sale communi reperiendum alcalinum ens, cum denique illud artificiis variis separaverim & demonstraverim, nihilominus cum antea recensitis sedecim proprietatibus perfecte haud congruens purum, sed a sale alcali fixo vegetabili ordinario valde discrepans alcali existat. Ex quibus generaliter denique concludo purum sal alcali fixum naturam minime nobis porrigere, consequenter omnia salia alcalina pura tota ARTIS PRODUCTA esse.

*Pure alkali
salts produced
only by art;*

Regnum

*And chiefly
from vegeta-
bles.*

Regnum vegetabilium, vel hisce adnumeratas res naturales, si non in totum, maximam tamen partem, pro subiecto & materia agnoscunt ex quibus in maxima copia produci & elaborari queunt; nam licet hinc inde parum quicquam demonstrativi in regno etiam animali exhiberi quandoque possit, attamen, excepto illo in urina & fæcibus a dicto sale communi dependente, in tam parva quantitate existit ut attentionem haud mereatur. Rationem quare tam parum vel nihil alcalino-fixi exhibeat suo loco pro viribus paucis subjungam.

Mirum interea videtur & paradoxum, quando de origine & existentia salis alcali dicimus, produci illud ex re quadam quæ nec granum salis alcalino-fixi continet; quemadmodum ex omnibus istiusmodi rebus ex quibus multæ libræ imo centenarii salis alcali fixi eliciuntur, ante operationem in igne vel ante incinerationem vel combustionem, nec granum hujusmodi in tentaminibus singulis probati salis alcalini ad sensum educi potest; sed si salini aliquid detegitur, ad acidum potius quam alcalinam naturam verget; unde sal alcali fixum non eductum, sed revera productum & artificiale existit.

*Principally by
means of fire.*

Præcipuum instrumentum ad productionem salis alcalino-fixi est IGNIS, utpote in quo prærogativa artis præ natura in tantum consistit, dum hunc pro lubitu & placito excitare, minuere & augere, variaque corpora cum ipso resolvere & componere valet, quomodo & quando ipsa cupit: & cum hoc, nempe quod salia alcalino-fixa mediante igne producantur, quidam chymici verbales forte audiverint, hi derepente nudum instrumentum pro materia salis alcalini vel pro principio constitutivo ipso venditarunt, & universam salis alcalino-fixi formationem particulis ignis adscripserunt; cum tamen quotidiana experientia plane diversum, & quod ignis undique tantum ut instrumentum ad ejus formationem cooperetur visibiliter convincat & demonstrat, prout & ipse in sequentibus de hac re ulterius mentem meam sum explicaturus.

*Requisites for
producing such
salt.*

Subjectum ex quo sal alcali fixum produci debet duo requisita ingredientia contineat necesse est; nimirum ut, 1. In se sit inflammabile, & oleosis vel bituminosis partibus, & 2. Sale quoque acido dotatum. Quod si has absolute & necessario requisitas proprietates in uno subiecto conjunctas reperio, tum satis quoque sufficiens est ut sal alcali fixum largiri queat; unde omnia fere vegetabilia, vel eorum partes incorruptæ, aptissima existunt; uno vero utrorumque deficiente parum quoque vel nihil salis alcali fixi inde emerget. Hoc ergo fundamento omnis salis alcalino-fixi in mundo productio innititur; & pro diversitate proportionis horum duorum ingredientium, etiam ex hoc vel illo subiecto modo plus, modo minus, modo debilius, modo fortius, vel alio modo diversum sal alcalino-fixum acquiritur. Si igitur sal alcalino-fixum producturus de quodam vegetabili, sive sit herba, radix, lignum, cortex, vel quicquid ejus sit, si antea per alios labores de contenta in eo olei & salis acidi proportionem sufficienter edoctus fuero, tum in antecessum quoque judicare potero

potero an multum vel parum salis alcali fixi daturum sit: si enim parum vel nihil olei possidet parvam quoque salis alcali proportionem subministrabit, & si parum vel nihil salis acidi contineat, vel acidum volatilius existat, multo minus adhuc suppeditabit; posterior hæc circumstantia plerumque in causa est quod non raro ex magno ligni acervo, vel aliis vegetabilium partibus, parum salis alcali erui possit; & sicut indubitatum existit quod omne sanum vegetabile partes inflammabiles contineat, ita contra multa ex iis vel parum salis, vel etiam volatile & sub incineratione plerumque diffugiens, sal acidum continent. Dari quoque possunt plantæ, ligna, radices & similia, salis & olei ditissima, quæ vero, dum incinerari debent, propter nimiam aeris interclusionem tantummodo vaporant, & in carbones, non vero in cineres exuruntur; qua circumstantia omne fere sal acidum, quamvis ejus non parvam quantitatem contineant, (præcipue si vegetabile adhuc viride nec satis exsiccatum sit) sensim exhalat, & quod restat cinerem in pauca, sal alcali fixum in longe minori adhuc quantitate suppeditat. Res demonstrari potest in pinu, vel quovis ligno quo communiter ad urendum utimur: si ejus aliquot centenarii recipiantur, iique leniter aperto aere comburantur, sufficientem cinerem, & ex his notabilem quoque salis partem nanciscemur: si vero ejusdem ligni totidem centenarii in parvos acervos construantur, carbonariorum more, vel alio quoque modo ligno apertus aer adimatur, ejusque modo tantum ei permittatur ut vaporare possit, breviter carbones consueti exinde conficiuntur, & quidem ea ratione ne ulli carbones inflammantes qui in igne aperto aere flammam edunt restent; ejusmodi puros carbones si tum aperto aere incineres, eosque in comparatione quantitatis priorum cinerum ponderes, demum sal alcali inde elixiviando separet & itidem ponderes, immensum quanto minus cinerum & salis in respectu prioris quod ab initio statim aere aperto incineratum fuit suppeditabit. Nulla alia ex ratione hæc ponderis diversitas ex ejusdem quantitatis ligno oritur quam quod in confectioe carbonum pleraque pars salis acidi vel communiter ita appellati spiritus lignorum, in aerem aufugerit, quæ tamen necessario ad constitutionem salis alcalino-fixi, tanquam primum ingrediens, requiritur.

Consideratu dignum est quod pro acquisitione cineris vegetabilis absolute admissio aperti vel liberi aeris requiratur, quippe sine quo nulla ratione cineres acquirantur; unde carbones, occluso aere, etiam fortissimo & per aliquot annos constanter durante igne, semper carbones permanent, & nunquam in cineres rediguntur. Nec minus notatu dignum est quod inter carbones & ex eodem ligno confectos cineres tanta occurrat differentia. 1. Ex carbone, quantacunque etiam aquæ copia, ne hilum quidem salis alkalini elixivari potest. 2. Nullum ne quidem fortissimum & potentissimum acidum ullum effectum in carbone exerit. 3. Nullus carbo cum vitro sese miscet, quæ singula tamen cineres præstant.

Sed

Sed ut ad formationem salis alcalini seu necessaria ad id constituenta revertamur, veritas & probatio meæ thesæos ex pluribus adhuc momentis & circumstantiis ulterius satis patet. 1. Recipiaturs ejusmodi putridum, cariosum & quasi emortuum lignum, quod alias dum in decenti vigore adhuc existit largam satis lixiviosi salis quantitatem edere solet; comburatur, elixivietur, & procedatur in omnibus eadem ratione ac si sanum lignum fuisset, & notetur quam parum vel nihil salis alcali fixi exinde provenerit. Ratio est manifesta, quia necessario ad ejus formationem requisitæ, tam oleosæ, quam præprimis quoque acidæ salinæ partes antea in aerem exhalant & evanuerunt. 2. Assumatur planta recens, quæ manifesto sufficiente salis acidæ quantitate à natura dotata est, separetur exinde sal acidum, seu ita dictum sal essentialiale, quo facto herba exsicceatur, comburatur & elixivietur cum omni cautela; ad oculum patebit quam parum vel nihil salis alcalino-fixi suppeditatura sit. 3. Eadem autem herba eademque quantitate assumpta, absque tamen salis acidæ vel essentialis separatione, tantum siccata, combusta, & modo consuetò elixiviata, visibiliter & aperte per auctiorem salis alcali fixi quantitatem veritatem demonstrabit. 4. Vel accipiaturs ante extractum sal essentialiale acidum, calcineturs debita cum cautione, & ex eo quoque, quia ejusmodi salia essentialia non pure salia acidæ, sed etiam aperte oleosæ & ad formationem alcali altera ex parte necessariis partibus dotata sunt, verum sal alcali fixum parabiturs. 5. Quod si porro eadem recentis ejusmodi herbæ quantitas quæ ordinario bonam satis salis alcalini portionem dare solet assumatur, factaque ponderatione tota quantitas in duas partes accurate dividatur, ejusque pars dimidia sicceatur, comburatur, & modo consuetò sal alcali fixum inde elixivieturs, ponderetur & conservetur; altera vero pars dimidia ad putrefaciendum reponatur, & ita tractetur ut penitus putrescat, tum destilleturs, ita acquiramus, ut notum est, spiritum urinosum, sal volatile & oleum empyreumaticum; sed respiciatur postea quantum sal alcali fixi ex residuo jam extrahi possit; licet enim summa cum cautione elixivieturs perparum & sæpe plane nihil emerget; ratio iterum non obscura est, quia requisita ad fixum sal alcali, sal acidum & oleum, durante putrefactione metamorphosin passa, & partim in sal volatile vel spiritum urinosum conversa, partim etiam & quidem pleraque ex parte in oleum in substantia & forma olei per destillationem inde separata fuerunt. 6. Quod si ad manus sit purus citri succus, qui aperte sal acidum, aut paucas vero oleosas vel de principio inflammabili participantibus partes simul continet, ejusque ad 20, 30, vel plures congios assumatur, aquosum evaporetur, inspisseturs, comburatur & elixivieturs, tum exinde quoque formatio salis alcali fixi manifesta reddetur. 7. Quam optime autem sensibus nostris hæc patebunt in tartaro, vel ejus crystallis quoque; quippe qui, ut notum est, nihil aliud quam sal acidum permultis oleosis partibus imbutum continet; si ergo hæc duo hic conjuncta requisita primaria, nempe sal acidum & oleum

oleum ustulentur & comburantur, tum ex residuo nullum amplius apertum sal acidum, è contra vero de novo utique productum sal alcali, & quidem copiose acquiritur; & sic cum omnibus subjectis demonstrari potest.

Quod vero oleosa quoque substantia non parum de suo contribuat, inter alias diversas demonstrationes etiam ex unica hac cuique facile in sensus cadente circumstantia colligi potest; quod si ex. gr. quatuor libræ siccati absinthii incinerentur, & ex lixivio sal fixum colligatur, accipimus præterpropter $2\frac{1}{2}$ uncias salis alcali fixi. Jam vero recipiantur itidem 4. libræ ejusdem absynthii, contundantur, & conscindantur, & pars ipsius oleosa, bituminosa, seu resinosa, per spiritum vini rectificatissimum quamdiu spiritus tingitur extrahatur; tum plurimum quidem, non tamen omne & universum in eo contentum inflammabile educes, omne tamen salinum in ipso interim remanet; quod restat postea, exsicceetur, comburatur, sal inde elixivietur & ponderetur, tum loco ante dictarum $2\frac{1}{2}$ unciarum jam unica tantummodo salis uncia prodibit; ex quo ergo iterum apertissime necessarium, sub priori combustionem relictum & ad majorem salis alcalini fixi portionem contribuens, in posteriori vero mediante extractione spirituosa sejunctum & jam proinde absens ingrediens bituminosum seu oleosum demonstratur. Pro ulteriori demonstratione, hæc jam memorata ab extractione spirituosa residua per aquam excoquantur, herba tum restans exsicceetur, comburatur, elixivietur, ejusque sal colligatur, tum ejus tantummodo 19, vel 20 grana acquiruntur; ratio est quia ex his 4. herbæ libris jam omne fere oleosum & sal acidum, quæ ad compositionem & formationem salis alcalino-fixi requiruntur, extractum fuerat.

Cum ergo clare satis pateat, quod ad formationem salis alcalino fixi acidum & principium quoddam inflammabile absolute requirantur, prout comprobavi, pro primo facile exinde quoque colligi potest quod aliquid ex his 2. tam necessariis ingredientibus simul in eo restare debeat, prout & revera restat. Ignis, qua instrumentum quod ad confectionem salis alcali adhibendum est, nihil aliud peragit quam quod 1. Omnem superfluam aquam, 2. Omne itidem superfluum sal acidum in forma spiritus, 3. Volatile demum & superfluum oleum separet. Quemadmodum igitur omnia salia, sive acida sive alcalina sint, seu quoquo modo appellentur, nec minus omnia inflammabilia terram pro basi vel fundamento agnoscunt, quæ terra imprimis oculis sese sistit si ejusmodi mixta magis magisque à connexis cum ea volatilibus partibus liberantur, & contra ad magis magisque fixum statum reducuntur: ita hoc quoque hic in generatione vel compositione salis alcalino-fixi videre licet; dum enim ignis sensim aliquid de volatiliori inflammabili & sale acido cum aqua propellit, uno eodemque tempore residuum magis fixum tam sal acidum quam bituminosum magis magisque concentratur, quando sensim necessaria ad constitutionem salis acidi aqua perit, quæ a calore

*Alkali salts
how formed,
and of what
they consist.*

ignis ex fale acido liberatur & exhalare cogitur; eodem, inquam, tempore separatur, altera ex parte, terra quæ in fale acido fuit; quo diutius ignis continuatur vel subjectum incineratur eo plus aquæ subtilis, subtilis acidi & inflammabilis abigitur, & tanto plus altera ex parte terræ acquiritur, vel tanto facilius degenerat fal acidum cum pauca phlogisti portione in terram: unde maximum volumen salis fixi ex pura terra consistit: verum quia hæc terra originem suam ex fale acido educit, &, ut ita loquar, naturæ acidæ est, impossibile est ut etiam sub prima incineratione vel calcinatione omne fal acidum ex ipsa liberari possit; sed ultimum potius maxime concentratum &, in comparatione prioris multo volatilioris, jam maxime fixum, ut & magis fixum substantiæ inflammabilis in quavis particula hujus terræ impactum restat & inhæret. Salinum hoc causa existit quare omnis hæc terra dispositionem solubilitatis cum aqua retinet, & paucum illud quod ex inflammabili ortum ducit causa hic quoque est causticitatis, secundum proportionem & modum immixtionis sui.

Ex eodem quoque fundamento, quia scilicet hæc terra acidæ naturæ & familiæ est, prodit quoque constans quasi desiderium fal acidum rursus assumendi, quod ipsorum affinitas & intima commixtio cum omnibus acidis, quin imo nuperrime à me demonstratus magnetismus quo salia alcalino-fixa acidum quoque ex aere attrahunt, tanto magis confirmat. Hoc quoque concentratum & restans paucum fal acidum, ut & hæc ad salinam mixtionem prona & jam ab omni aqua liberata terra, aperte unica existit causa quod hæc mixta id rursus quasi concupiscant quod per calorem ignis amiserant, nempe aquam: inde oritur celeris illa & subitanea extractio humiditatis & solutio per deliquium, quin & incalescentia illa si fortiter combusta fuere & tum prima vice humiditatem sentiunt, quin etiam ipsa incensio, si minerale quid simul adhibitum fuit, quale quid in fale tartari caustico cum regulo antimonii martiali præparato, ut & pyrophyris videre licet. Quod si vero salibus alcalicis paucum hoc fal acidum & inflammabile plane adimitur tum nuda tantum restat terra, quæ nec in aqua amplius solvi potest, nec humiditatem nec acidum ex aëre attrahit, nec incalescentiam producit, & in omnibus quasi emortua apparet; quanquam chymicus eam rursus revivificare, & ad dispositionem solutionis & mixtionis cum aqua, imo ad plerasque priores qualitates reducere valet.

Omne quicquid de formatione salis alcalino-fixi superius attuli unico exemplo aliquatenus jam supra memorato plenarie demonstrare possum, vel quivis illud in propriam sui convictionem imitari poterit: recipiatur fal essentielle acetosellæ, quod visu, gustu, tactu, vel quovis modo ante examinatum [quamvis nemo quoque istud negaturus sit] apertum fal acidum, non tamen purum sed particulis oleosis mixtum, sistit. Si hujus e. g. uncia 1. assumatur & cum aqua uniatur tota sese penitus in aqua solvit, prout etiam ex solutione aquosa in crystallos antea concreverat, & ne minimum quidem indif-

solutum restat, ita ut nec oleum, nec terra, nec sal alcali, nec aliud quicquam peregrinum, sed pura salis acidi solutio videri possit. Jam recipiatur porro 1. uncia ejusdem sicci tamen & crySTALLINI salis, imponatur ea vasculo retorto vitreo, & debita cum cautela igne per gradus adhibito destilletur, tunc sensim omne istud quod antea in suo ordine circa confectionem salis alcali recensui hic mediante ignis instrumento, quod nihil aliud quam vasculi retorti & contenti in eo salis incallescantiam causatur, evenit. 1. In vas recipiens superflua, quæ tamen in sicco sale antea latitarunt, aqua & oleum cum subtilissimo & volatilissimo sale acido prodibunt. 2. E contra non parum terræ inde rursus separabitur, & residuum, cui aliquid salis concentrati & olei quasi fixioris sese innexuit, in perfectum sal alcali fixum degenerabit. Invenientur circiter 3. drachmæ aquæ paucio sale acido volatili imbutæ, qui liquor spiritus acidus acetosellæ vocari potest; scrupulum forte unum olei empyreumatici ponderabis, & in retorto restans caput mortuum conficiet circiter 4 drachmas & aliquot supra 20 grana, ex quo plus quam 3 drachmas veri sicci salis alcali fixi elicies; ita ut pauca tantum grana exhalarint & dispersa sint, quæ de tota uncia, si ex omnibus computum traxeris, forte deficient. Hic ergo omnia prodeunt quæ dixi; verum præter sal alcali &, quæ primo abiit, aquam & subtile acidum, oleum quoque adest & terra plane emortua, quæ duo posteriora jam nullo modo cum aqua misceri amplius volunt, quamvis antea, cum adhuc totum sal acidum oleosum constitueret, omnia in eodem solverentur. Potest quoque sal alcalino-fixum destrui, parva illa acidi & inflammabilis portio ipsi adimi, indeque quantitas terræ augeri, & sic unico hoc experimento omnium harum rerum certitudo erui.

Consistit itaque sal alcali fixum ex terra quadam solubili, in quam mediante igne aliquid de fixissimo sale acido sese insinuavit, simul quoque aliquid de magis fixo, vel ad terrestreitatem magis inclinante bituminoso, seu inflammabili principio, ustulando quasi innexum est, ita ut novum mixtum salinum quod chymici sal alcali fixum vocant constituat. D. Homberg qui [prout D. Stahl memorat] primum pharmacopœus, postea vero clarissimus chymicus Lutetiis Parisiorum fuit quem Gallia ad ipsius usque tempus unquam habuit, hac in re errorem passus est, dum sal acidum tantum agnovit quod sese terrestribus particulis innecteret & sic sal alcali fixum constitueret, de inflammabili vero nullam mentionem injecit. Qui adhuc vivunt senior D. Geoffroi & D. Lemery, duo præcipui hodierni Galliæ chymici, in tantum quidem suis laboribus observarunt quod aliud quippiam adhuc præter supra dictum sal acidum & terram, nempe aliquid de principio inflammabili ad constitutionem salis alcali necessario requiratur; sed rursus in eo defecerunt, quod hoc instrumento, seu igni, assignare voluerunt, cum tamen in isto ad sal alcali fixum adhibito subjecto vegetabili, reale ac substantiale ingrediens oleosum vel bituminosum uniuscujusque oculis obversetur. Porrigatur

his dominis ejusmodi subjectum in quo antea nullæ actuales partes inflammabiles demonstrari vel conjecturari possunt, sed in quo tantum sal acidum & partes terrestres probari queunt; hoc subjectum ipsi poterunt in vase retorto per 20 & plures annos, cum multis centenariis extrorsum vasi retorto adhibitis particularum ignis & materialium luminis [parties de feu & matieres de la lumiere] vel qua ratione ipsi volunt tractare, ea tamen cum expressa præcautione ne cineres ipsos harum adhibitarum instrumentalium materialium ignis addant, certo certius est ipsos ne unicum quidem granum salis alcalino-fixi exinde philosophando educturos, licet etiam totum Cartesium simul igni consecrarint: jam vero si ex ipsorum opinione ignis ingrediens vel constituens materiale ipsius existeret, necessum foret ut absolute etiam ex ejusmodi rebus, in quibus nullæ essentiales partes inflammabiles præsto & immixtæ essent, illud conficere possint: quod si in actum deducere non poterunt, prout revera non poterunt, sed semper materia in & ex se ipso inflammabilis assumenda venit, quare non ipsas actu realiter præsentibus adhibitas, plane certas & demonstrativas res, tanquam causam respiciam, vel quare memet huic & illi philosopho vel chymico cerebrino, qui forte per totam suam vitam nullum carbonem manibus tractavit, & chymica subjecta & historias non ex ipsorum intima qualitate & realiter constituentibus materialibus partibus diversarum in iis contentarum materialium, sed tantummodo ab extra, mediante circulo, linea, & microscopio, vel etiam quæ cum iis dimensurare & perspicere non potest secundum propriam chymericam in cerebro tantummodo propositam & in chymico laboratorio nunquam comprobata nec unquam comprobendam imaginationem judicat, subjiciam, ipsiusque deliramenta adorem? Quod autem ignitio, vel ignis, qua instrumentum tantum, ad productionem salis alcali fixi requiratur, inter cætera ex tartaro quoque patet, quippe qui utraque primaria præsidia possidet. Possidet, ut notum est, partes oleoso-bituminosas, continet etiam apertum sal acidum, & utrumque in abundantia; quod si autem ex hoc sal alcali absque igne artificiose deberet produci, tum nihil amplius adhibendum foret quam volumen, vel terra quædam in quam parum acidi & inflammabilis sese innecteret; proinde pro hoc scopo oculos cancri, vel aliud corpus terreum, quod ad minimum cum nullo alio acido imbutum esset, adhibere possent. Solve igitur in tartari solutione tantum ante dicti terrei corporis quantum solvi potest, evapora aquam & exsicca; tum ex propria mea hypothese quod sal acidum & inflammabile in terra concentrata absolvant sal alcali fixum, vel quod sal alcali fixum ex copiosiore terra & pauciore sale acido & inflammabili fixiore consistat, mixtum quoddam quod in pluribus circumstantiis ut alcali fixum sese gerit oculis sistes; verum examinetur ulterius secundum omnes à me allatas probationes veri & perfecti salis alcalino-fixi, tum mox hic mox alibi patebit multa adhuc illi deesse, & quomodo totum mixtum, solutio tantum oculorum

cancrorum

cancrorum in acido tartari, adeoque superfluum acidum & oleum, breviter ipse tartarus crudus adhuc simul in illo immersus & irretitus sit, per consequens nullo modo verum & perfectum sal alcali fixum constituat, nulla alia ex ratione quam quia nullus ignis adhibitus fuit, non quasi ex igne plures adhuc particulæ ignis ad hoc necessariae essent, siquidem hic adhuc superfluae inflammabiles partes in oleo tartari præsentes sunt, sed propterea quia superfluum oleum & acidum exinde separari debuissent; unde etiam in hoc experimento formatio salis alcali ad oculum patet, simulac modo plus acidi & alcali per adhibitum calorem sensim expulsum, & operationi per necessarium instrumentum colophon impositus fuit. Industrius olim Kunckelius jam tum temporis animadvertit quod ex tartaro & calce viva, si utraque cum aqua coquendo elixivientur, possibilis demonstratio salis alcalini absque adhibita sicca ignitione haberi possit; quum vero cum præcedentibus circiter conveniat, & eadem ratione quædam partes olei empyreumatici tartari adhuc aliquatenus restent, superfluum existimo istud adducere, prout & alias non paucas adhuc cum variis acidis imprægnatas terras, vel plenarias terrarum solutiones, tanquam falsa salia alcalino-fixa adducere possem, nisi prolixitati parcerem.

Satis notum est quod ex omnibus vegetabilibus, vel potius eorum cineribus sal alcali parari possit, nec non quod ex permultis herbis & permultis aliis partibus à non exiguo temporis spatio ejusmodi lixiviosa salia confecta fuerint, & denique quod eodem modo omnia conficiantur; nihilo minus quædam adhuc de hac materia, tam in genere de salibus fixis herbarum, quam etiam in specie de residuis adhuc in chymia usualibus salibus alcalino-fixis, seu potius eorum præparatione, quantum fieri potest, brevibus adducam.

Modus procedendi ab aliis in 9, ab aliis vero in 6 puncta distribuitur; qui in novem puncta ipsum dispertiuntur appellant operationes vel labores, qui pro hoc scopo cum subjecto vegetabili perficiuntur prout ex ordine sequuntur, desiccationem, combustionem, extractionem, separationem, inspissationem, calcinationem, solutionem, filtrationem & inspissationem. Qui vero 6. puncta tantum requirunt appellant hos labores, desiccationem, combustionem, extractionem, separationem, inspissationem & depurationem. Ego ad quatuor eas reduco, nimirum incinerationem, elixiviationem, inspissationem & depurationem, dum scilicet unus labor alterum semper præsupponit; si enim de incineratione loquor, quod nempe vegetabile primo in cineres exuri debeat, tum hoc jam præsupponit desiccationem. Si de secundo puncto elixiviatione scilicet loquor, vel ipsæ anus norunt quod nullum lixivium absque aqua vel extractione fieri possit; norunt quoque quod hæc extractio, si lixivium appellari debet, à cineribus separanda sit, ut proinde elixivatio extractionem & separationem utique præsupponat; & sic etiam sub operationibus depurationis necessariae ad eam calcinationes, solutiones, filtrationes & inspissationes intelligendæ veniunt.

Of the most usual fixed alkalis, and how obtained.

Totus

Totus processus salia alcalia fixa ex herbis producendi his absolvitur momentis. Herba leniter siccetur; tum partem ejus aliquam de alio igne incende & in ignem sensim reliquum herbarum constanter projice, ita ut leni tantum carbonum igne, minime vero aperta flamma, in cineres redigatur; cui rei non parum favet si hic carbonum ignis circa ultimum in magis magisque angustum semper acervum colligatur. Ubi tandem penitus exustio peracta est refrigerat, cinis cribretur, ut restantes forte non plane incineratæ particulae separentur, cinis aqua frigida plenarie elixivietur, lixivium filtratur, filtratum vel in figulino vel vitreo vase leniter evaporetur, denique ad siccitatem inspissetur. Medico usui si adaptari debent, & si medicus externam plane non necessariam, imo potius noxiam quam utilem, pulchritudinem & candorem putat, tum prima hæc inspissatio sufficere poterit; quod si vero depurari, imo ex parte plane crystallifari debent, tum calcinentur parum, & denuo in magna satis portione aquæ solvantur, filtrentur, rursusque leniter evaporentur, donec in superficie parva cuticula apparere incipiat; tum in fundum detruncatæ cucurbitæ vel aliud ampli orificii vitrum infundatur, & imposita leviter charta a cinere vel aliis sordibus defendatur & in locum temperate calidum reponatur, tum sensim magna pars in pulchras & egregias crystallos jucundo sæpe spectaculo vertetur, præcipue si lixivium ante apparitionem cuticulæ ab igne auferatur, & in locum lenissime calidum ad crystallifandum reponatur, & absque ulla motitatione satis temporis ipsi concedatur. Postquam igitur in crystallos concrevit restans lixivium ab iis decantetur, pars humiditatis rursus leni igne exhaletur, rursus in ante dictum temperatum locum reponatur, ut residuum, quantum fieri potest, crystallifet, quæ tamen crystallos plerumque pulchritudine ad priores non accedunt, sed multo minores, imo plane aliter formatæ esse solent. Quod tum vero superest liquidum decantetur, & tandem plenarie inspissetur; crystallos autem semper pauca aqua destillata communi celeriter abluantur, & tum super pura charta bibula ab adhærente humiditate leniter siccantur. Si vero non crystallos, sed tantum depuratum album sal alcali desideres, post primam calcinationem, solutionem & filtrationem, ad siccitatem leniter inspissare, & tum in obturato firmiter vitro ab aëre bene præmunire poteris. Hæc igitur est generalis methodus qua salia lixiviosa herbarum, florum, stipitum, &c. purissime & optime præparari possunt, ubi tria adhuc monenda erunt; 1. Quod simulac una tantum vel altera levis circumstantia in antedicto processu immutatur, quæcunque illa fuerit, statim & infallibiliter modo hic, modo alibi immutatum sal acquisiturus sis. 2. Quod in ejusmodi depuratis & crystallifatis salibus lixiviosis nulla quæ in subiecto antea fuit specifica virtus demonstrari queat. 3. Quod omnia usitata & præcipue crystallifata salia herbarum nunquam pura salia alcalino-fixata sint, aut pro talibus adhibere debeant ad alios chymicos labores in quibus purum sal alcali fixum requiritur.

Tachenius

Tachenius & cum eo alii contendunt herbas recentes plus salis largiri quam siccatas; Rivinus autem pernegat, & ait se id omni adhibita diligentia observasse, & de eadem herba probam sumfisse; sed nulum discrimen in iis potuisse reperire. Meo quidem iudicio uterque certo modo verum dixit: nam si ejusmodi vegetabile tractes quod nullum subtile vel volatile sal acidum continet, tum ex siccato idem pondus salis ac ex recenti acquies: vel etiam si herbam recentem aperto igne flammæ, siccata contra leni tantum candefactionis igne incineres, itidem semper idem fere aut saltem parum differens pondus quamvis non ejusdem indolis salis alcalini emerget, adeoque hac ratione Rivini quoque opinio veritati consona est. Sed si ejusmodi vegetabile sub manus sit quod vel tenerum, subtile, vel etiam cum aliis partibus obiter tantum commixtum sal acidum continet, quod sub incineratione facillime aufugit; tum utique recens aut saltem non adeo plene exsiccatum multo plus salis largietur quam aliud, licet tamen unam vel alteram adhuc enchirefin requirat, & hac ratione Tachenius applausum meretur. Dantur vegetabilia quæ omni licet industria & præcautione sub incineratione adhibita, tamen subtile suum & ad fabricam salis alcalici necessarium sal acidum dimittunt, ita ex magna satis quantitate perparum tamen salis alcalici fixi acquiratur. Quod si autem exhalatio salis acidii hoc vel alio modo impediatur, tum ad oculum plus salis alcalini fixi prodibit; id quod rursus ea quæ de generatione & formatione horum salium dixi luculenter confirmat. Quo hoc magis patefcat, recipiatur tantum lignum guajacum vel sanctum, quod sub deflagratione sal suum acidum perquam facile dimittit; hujus si satis magna quantitas exuratur, incineretur, & ex cineribus omni cum præcautione sal alkali colligatur, perquam exigua ipsius quantitas erit secundum proportionem assumpti ligni; quia scilicet subtile acidum sub deflagratione & effumatione plurima ex parte diffugit; quod si autem eadem ligni quantitas in minutissima frustula concidatur vel plane raspetur & cum magna aquæ quantitate excoquatur, decoctum coletur, residuo ligno recens aqua affundatur, & excoctio continuetur donec aqua non amplius tingatur, decocta omnia confundantur, evaporentur, & in extractum inspissentur, quod leniter exsiccentur, & tum tam hoc quam residua seorsim siccata raspatura vel frustula leniter candefaciendo exurantur & incinerentur, tum elixivientur, & methodo consueta sal alkali ex iis colligatur, mirum quanto major ipsius quantitas inde proditura sit, quod & de non paucis aliis valet.

Præter allata salia alcalino-fixa herbarum, prostat etiam alkali quoddam lignorum minime pretiosum, & ad multas operationes non incommodum; hoc quamvis jam plene elixiviatum, inspissatum & calcinatum sal alkali revera existat, tamen communiter tam latina quam germanica, ut & quibusdam aliis linguis, cinis tantum appellatur; cineres clavellatos dico. Quicquid sit, five olim purus non elixatus cinis sub hoc nomine venditus indeque denominatio retenta sit,

fit, five alia causa fuerit, originem nominis inquirere operæ pretium esse vix existimo. Interim cineres clavellati unicuique satis noti sunt, & a quibusdam simpliciter sal alcali appellantur. Præparantur communiter ex cineribus lignorum duriorum, fagi, aceris, betulæ, fraxini, quercus & similibus: unde & quomodo parentur, & qua ratione optimi cognoscuntur, videre licet in Kunckelii arte vitriaria, Valentini musæo musæorum, & in tractatulo qui ars tinctoria experimentalis & fundamentalis insignitur. Hi cineres clavellati prout emuntur & venduntur non constituunt plane purum & ad omnes labores chymicos aptum sal alcali; quapropter adhuc semel depurandi sunt, quod non difficulter fieri potest, siquidem nihil aliud agendum quam ut iis aqua frigida, sed pauca, affundatur, solvantur, solutio filtretur, leniter evaporetur & inspissetur, tum eadem ratione & bonitate ac quodvis purissimum sal alcali adhiberi poterit. Id quod a decantata solutione restat & in aqua frigida solvi negat non est amplius purum sal alcali fixum, sed præter partes alcalinas adhuc etiam de sale acido, & quidem vitriolico, participat: nam si aqua fervide calente plene dissolvatur, filtretur, & solutio, postquam ex parte evaporata fuit, per aliquot horas reponatur, candidas & egregias cryсталlos reperies, quæ in omnibus probis & inquisitionibus ut verum sal enixum seu medium, quod ex alcali fixo & acido vitriolico componitur, breviter ut tartarus vitriolatus sese gerant; quod autem ab hac secunda cinerum clavellatorum cum aqua fervida tractatione solvi recusat & in filtro remanet, sunt inutiles plane fæces & sordes.

Præterea extat aliud purum sal alcalino-fixum, quod ordinario pro optimo habetur, & hætenus tam ad chymiam quam ad medicinam præ omnibus aliis adhibitum fuit; est istud sal tartari; qua ratione id paretur itidem res est satis superque nota, qui vero illud tenerius & penetrantius requirit duplici modo hoc adipisci poterit; vel calcinando, solvendo, filtrando & inspissando; vel etiam calcinando, per deliquium solvendo, filtrando & inspissando; hi duo purificandi modi si non sæpiuscule reiterentur in plerisque conveniunt, & tum differunt tantum in solvendo & deliquescendo: quod si autem una ex parte calcinatio, & altera ex parte deliquescencia sæpe sæpiusque instituatur & reiteretur, tum ingens utique & sat notabile discrimen ostendent.

1. Reiterata sæpe calcinatione sensim aliquid de restante adhuc inflammabili & sale acido, imo & de subtilissima terrestri parte ipsa destruitur, imo totum mixtum sal alcali constituens quasi invertitur & in puram in aqua non amplius dissolubilem terram commutatur: quod si supra adductorum autorum opinio vera existeret, & particula ignis ad productionem salis alkali tanquam materiale ingrediens concurrerent, hic plane non ad ejusmodi destructionem, sed potius ad augmentationem salis alkali fixi devenire deberet, dum hac sæpius repetita calcinatione recentes semper particulae ignis admoventur.
2. Repetita sæpius solutio per deliquium & inspissatio plane contrarium demonstrat, dum crudiores terrestres particulae ex salibus alcalinis

fixis separantur, extricantur; teneriores & subtiliores in his per deliquium solutis salibus retinentur; unde ejusmodi salia hac sæpe repetita per deliquium solutione eo tandem redigi possunt ut nec in frigore, nec in calore amplius siccam consistentiam recuperent, sed semper consistentiam humidam, fluxilem, forte ut oleum vitrioli, conservent, & in igne tenuiora crucibula potius solvant, crassiora autem citius penetrent quam in forma sicca.

Non inusitatum etiam sal alkali fixum est ita appellatum nitrum fixum, seu nitrum alcalisatum: quod licet cuique notum, ejusque præparatio tanquam vilis & nauci æstimari possit, meas tamen quoque circa istud negotium cogitationes, forte quibusdam scitu adhuc necessarias, jam exponam. Alkalisatio nitri sequenti innititur fundamento: simulac nitrum cum quodam bituminoso vel crasse terrestri inflammabili corpore miscetur & detonatur, statim una ex parte nitri resolutio, & contra altera ex parte generatio vel nova compositio salis alkali oritur; ubi bene notandum quod non tantum sal alkali fixum, sed & in eodem momento adhuc sal alkali volatile vel urinosum generetur; si, inquam, nitrum cum terrestri quodam inflammabili corpore commiscetur, exempli gratia, bitumine, pice, colophonio, fuligine, tartaro, mastiche, sulphure communi, carbonibus, gummi sandarachæ & similibus, alkalisatio statim procedit simulac cum iis detonatur vel deflagrat; sed cum subtilioribus mixtis inflammabilibus, ut spiritu vini rectificatissimo & ipsis oleis destillatis, non ita procedit, nisi singularia artificia adhibeantur. Vilissimum & proinde etiam usitatissimum additamentum sunt carbones pulverisati; ne autem hunc tibi conceptum in animo formes ac si sal alkali ex adhibitis carbonibus ortum duceret, siquidem tota carbonum libra tantum aliquot drachmas cinerum, hi cineres vero tantum aliquot grana salis alkali fixi largiuntur, id totum fere a nitro ipso dependet, unde quoque pro ulteriori adhuc pensatione adducam sequentia momenta. Libra una optime depurati nitri crySTALLINI continet præterpropter partem dimidiam aquæ, unam quartam salis acidi, & unam quartam additamenti alcalini, quod ad corporificationem acidi nitrosi & ad figurationem formæ crySTALLINÆ in conficiendo nitro additur; unde quoque totum nitrum sal medium existit; quod si autem huic libræ nitri tres vel quatuor carbonum uncias admisceas, quæ per se circiter 3. vel 4. grana salis alkali fixi suppeditant, & cum hac carbonum quantitate ante dictam nitri libram alcalises, accipies 8 vel 10, imo, si recte operatus fueris, fere 12 uncias purificati & boni salis alcalini. Jam ergo oritur quæstio: unde tantum pondus? siquidem vix 4. uncia additamenti alcalini in tota nitri libra præsto sunt. Quisque rem hanc ulterius consideret, & ea quæ de origine salis alkali fuisse satis dixi in consilium trahat; forte tum quæstionem hanc sibi ipsemet facile dissolvere poterit.

Dixi in genere nitrum cum omnibus crasse terrestribus inflammabilibus subjectis alcalisari posse; sed ne cogites proinde velim etiam

in genere unum & quoad omnia semper idem sal alkali fixum inde proditurum esse: minime; sed prout inter inflammabilia additamenta ipsa modo hoc modo illud discrimen reperitur, ita semper utique aliquo modo diversum, modo magis vel minus subtile, crassius, modo summe causticum, vel etiam obtusius, semper tamen nitrum fixum, quamvis non ubique & omni ex parte plane æquale, sed modo hic modo alibi differens alkali; quod vel a proportionem, vel ut plurimum a differente indole & natura additamenti, ut & singulari ratione ab isto magis magisque fixo vel in aliis fixis materiis concentrato inflammabili dependet, ex quo causticitas quoque primario ortum suum deducit; e. g. si nitro ejusmodi subjectum admisceo in quo inflammabile copiose quidem, sed tantum superficie tenus præsto, imo cum multa aqua adhuc extensum & proinde magis ad volatilitatem dispositum est, ut in resinis, pice, colophonio & similibus, tum accipio quidem nitrum fixum seu alkalifatum, sed longe non adeo causticum ac si ejusmodi subjectum addo in quo phlogiston magis fixum & terrestre factum est, quod iterum ex. gr. per additamentum reguli antimonii martialis facile demonstrari potest; quippe in quo solummodo concentratum principium inflammabile terreæ indolis ex Marte causticitatis vera causa existit; qua occasione non diffiteor memet ipsum, in quantum adhuc originem causticitatis consideravi & observavi, huc usque nullum sal alkali fixum absque additione subjecti mineralis causticum reddere nosse & posse, ut propterea hæc materia ulteriore adhuc disquisitione indigeat; imprimis cum & alia occasione ostenderim qua ratione ex eodem plane fundamento sal alkali volatile causticum produci queat.

Ordinarium nitrum causticum fixum ex partibus anaticis reguli antimonii martialis & nitri crystallisati pulverisatis ante & mixtis cæmentando paratur, prout notum est. Quin & regulus antimonii, calx viva, ut & plura alia mineralia tartaro crudo ejusque sali, imo etiam ipsis depuratis cineribus clavellatis, methodo satis nota enormem causticitatem inferunt, ita ut ordinarium cum calce viva & depuratis cineribus clavellatis, vel sale tartari paratum, & ordinario quoque appellatum sal alkali causticum omnia corpora tenacia animalium, ut pennas, crines, lanam, ossa, cornua, ungulos, &c. in mucum, & pinguedines parvo temporis spatio in saponem, sulphur autem in rubrum liquorem dissolvat. Quod si hoc sal in forma liquida solutum existat appellatur lixivium saponariorum; si adhuc semel in crucibulo fundatur & in exiguas oblongas portiones effundatur, tum lapis infernalis alcalicus, cauterium potentiale, & quibusdam sal chirurgorum appellatur.

Tandem præter duas has a me allegatas magisque consuetas nitrum alkalifandi methodos adhuc tertia huc illuc usitata est; nimirum, si nitro carbonum vel reguli loco tartarus pulverisatus addatur. Quamquam hoc præparatum ex usitata consuetudine nunquam nitrum fixum, sed postquam elixiviatum & inspissatum fuit potius sal tartari extem-

poraneum, & si non elixivatum vel depuratum fuerit apud aurifabros, docimastas, metallurgos, monetarum tractatores, zonarios, aliosque circa metalla versantes artifices, fluxus niger appelletur: Verum & hoc nitrum fixum non ita promiscue pro quovis alio sumendum erit, si quidem itidem pro diversa dictorum duorum ingredientium proportionem etiam diversa salia emergunt. Quod si igitur fluxum hunc nigrum præparare volo recipiuntur 1. vel partes æquales utriusque, vel etiam 2. nitri pars una & tartari partes duæ vel tres: artifices solent utrumque seorsim pulverizare, pulveres utrosque miscere, tum in purum ferreum mortarium injicere & pruna candente incendere, & plerumque hoc ita crude adhibent, absque ulla elixatione, filtratione & inspissatione, seu depuratione. 3. Quod si vero prima statim detonatione album plane sal desidero, tum ad tres vel duas nitri partes tantum unica tartari recipitur. Circa has tres diversas proportionem, ut ante jam notavi, etiam sequentes diversæ circumstantiæ occurrunt. 1. Si 2 partes nitri ad unam tartari partem assumantur, tum non omne nitrum plane alcalisatum existit, sed ex parte adhuc crudum est. 2. Si 2 vel 3 partes tartari cum 1 parte nitri commisceantur, tum omne nitrum quidem resolutum & alcalisatum est, sed e contra non omnis oleosa tartari substantia consumpta & exusta est; unde quoque idcirco hæc proportio tantum & unice ad liquefactiones & reductiones metallorum præ aliis proportionibus longe commodior, aptior & utilior deprehenditur; interim & hoc (si volupe fuerit) instituta de novo calcinatione a superfluis oleosis partibus liberari, & sic in perfectum sal alcali redigi potest, quod vero tum sal tartari extemporaneum vocari non potest. 3. Proportio media ubi partes anaticæ assumuntur optima quidem videtur, interim negari non potest & eam adhuc quandam nitri crudi partem secum retinere.

Sub hac modo adducta, & tanto magis ex 2 partibus nitri composita proportionem, durante deflagratione, realis separatio principiorum vel partium constituentium tartari oboritur, ubi 4 notabiles circumstantiæ & momenta occurrunt. 1. Maxima pars oleositatis tartari non modo resolvitur, sed & ita consumitur ut vice ejus quod alias in destillatione tartari notabilis copia olei in forma fluida separatur & apparet, hic sub detonatione cum nitro nullum aliud ipsius vestigium quam parum siccae fuliginis ob oculos veniat. 2. Cum alias durante destillatione vel exustione tartari separatio olei, spiritus & phlegmatis una ex parte, & nova formatio salis fixi alcalini altera ex parte, per consequens omnia tarde eveniant & aliquod temporis spatium requirant, hic omnia simul & semel unico momento & unica detonatione procedunt. 3. Notum est quod tartarus & nitrum (quodvis seorsim) si destillantur spiritum acidum suppeditent, hic autem ubi hæc duo salina mixta conjunctim deflagrant, ne hilum quidem acidi emergit, sed rursus plane aliud, imo contrarium & de novo formatum, scilicet urinosum sensibus nostris sese sistit. 4. Cum in communi exustione tartari per se absque additamento, semper non ex-

igua portio terræ indissolubilis post perpetratam salis alcalici elixiviationem restet, hic in salis tartari extemporanei præparatione fere nihil indissolubilis terræ reperiatur, sed omne istud in purum sal, & quidem in momento & incomprehensibili celeritate convertatur.

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the same.*

*n. 393. p. 45.
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1726.*

If fixed alkalies differ, and in what.

VII. 2. **D**E salibus lixiviosis plantarum primum in genere notandum venit, quod in quantum forsitan una vel altera differentia interea sese exserit, ista plane non à specifica indole & singulæ viribus quas una vel altera planta ante combustionem & incinerationem possidebat ortum trahat, sed differentia ista primario dependeat à duabus aliis circumstantiis; (prout hoc experientissimus & insignis chymicus D. Stahl jam animadvertit) nimirum 1. à diversa structura vel teneriorum vel crassiorum partium plantæ; & 2. ab operatione vel mutatis in ea enchiresibus & parvis manipulationibus. 1. Ratione structuræ acquiritur e. g. longe aliud sal alkali ex subtilibus & teneris foliis quam ex crassioribus caulibus ejusdem herbæ; aliud e petalis florum vel totis floribus quam e lignis; aliud ex seminibus quam ex radicibus; aliud ex succo expresso quam ex extracto quod ex ficcata herba cum multa aqua & forti coctione paratum erat; aliud ex teneris recentibus herbis quam ex valde exsiccatis; & sic porro. 2. Ratione operationis acquiritur longe aliud sal alkali è leni tantum fumante excandescencia & incineratione quam è forti flammante combustionem; aliud ab elixiviatione cum aqua frigida quam cum aqua calida, imo cum reali excoctione ebullitoria; aliud si parum quam si multum aquæ adhibeas; aliud si parum & semel tantum calcines quam si fortiter & sæpius calcinatio reiteretur; aliud si sal inspissatum cum multa aqua iterum solvas quam si per se in deliquium fluere permittas; idque rursus secundum plures etiam alias circumstantias. Sed nisi salia lixiviosa de industria, forte per repetitas calcinationes vel deliquescentias, ad nimiam & maxime notabilem differentiam redigantur, in communibus ordinario usitatis laboribus & præparationibus horum salium reperibilis differentia parvæ vel nullius est considerationis, excepto si forte mineralè quippiam vel de industria, vel incuria, vel incitia adhibitum fuerit. Quod si ergo apud ordinaria pure præparata salia lixiviosa herbarum diversitas quædam tamen reperiretur, in hoc tantummodo consisteret quod unum magis pure alcalinum quam aliud, unum subtilius, aliud crassius, unum magis terrestre quam aliud, unum paulo magis causticum quam aliud, unum cum pluribus ab oleoso ingrediente oriundis partibus, vel etiam copiosiore spiritu acido imbutum, indeque magis crystallinum sit quam alia salia: de cætero singula sunt salia lixiviosa, singula salia fixa & alcalina, sed singula non sunt vere pura, cum purissima ex iis adhuc sint impura, & ad alias chymicas applicationes adhuc inepta salia alcalina, dum pleraque apertum quippiam & superfluum acidum, quædam etiam superfluum terram aliasque accidentales peregrinas immixtiones, si non voluntarias ineptas additiones, tanquam putatitia artificia pro acquirendis speciosis crystallis, contineat:

ita ut, si ordinaria in pharmacopoliis parata vegetabilium crystallina lixiviosa salia animo revolve, sæpe non satis mirari possim quare istiusmodi salia in hodierna praxi medica adhuc toto die adhibeantur, cum tamen medico ignotum sit quale sal ægrotis commendet, quia ejusmodi crystallifata salia nec pura alcalina, nec perfectè saturata salia neutra existunt, & per consequens accurate novit nemo quantum alcali & quantum acidi una drachma vel uncia talis pulchre crystallini salis contineat; item, an præsens ibi & ad crystallisationem disponens acidum vegetabile vel minerale sit. Quod si egomet in praxi medica sale alcalino fixo opus haberem, tum purum sal tartari vel etiam depuratos cineres clavellatos reciperem; quod si sal acidum ex usu foret, tum ex apertis puris acidis commodissimum seligerem, & si sal medium adhibendum esset, itidem ejusmodi ex usitatis plene saturatis salibus mediis, & quod ad præsentem ægritudinem pro commodissimo reputarem in usum vocarem; tum enim certo scirem quid ex pharmacopolio daretur & quid ægroti sumerent, reliqua autem incerta & imperfectè saturata salia, quæ nec pura salia acida, nec alcalina, nec media seu neutra sunt, secure negligerem.

Istam adhuc admonitionem dare volo, quod si forte adhuc unum vel alterum singularem effectum ab hoc vel illo sale vegetabili lixivioso expectare velis, & quod si possibile est ut quoddam sal alcalinofixum adhuc singulare quippiam in re medica præ alio possidere queat, ut ejusmodi herbam ad minimum quam lenissime excandescere sinas, non violenter incineres, multo minus fortiter exuras, omnium minime vero nec cineres nec sal calcines, tum forte specifica quæ expectatur virtus in paucis quibusdam restantibus revera oleosis partibus (quippe in quibus tantummodo sitam esse eam oportet) aliquo modo conservaretur; cum contra certior sim quod si absque consideratione & cautione igne flammæ exuratur, calcinetur & depuretur, nihil specifici nec singularis amplius reperiri queat. Quanquam igitur curiositatis gratia, ex una eademque planta, absque ullo peregrino additamento, unice mediante igne & aqua, permulta genera salium alcalinorum fixorum, quorum aliud ab alio parum licet semper tamen aliqua in parte, modo externo aspectu, modo etiam interna leviori circumstantia differre debet, præparare & producere norim; tamen altera quoque ex parte non ignotum mihi est quod non tantum hæc multiplicia ex una eademque planta artificiosè producta, sed & omnia lixiviosa herbarum salia, imo quod plus est, omnia salia alcalinofixa in orbe reperibilia ad eundem aspectum, virtutem & efficaciam reduci possint: ita ut hoc respectu & intellectu non nisi unicum & unius generis sal alkali fixum ex omnibus vegetabilibus in orbe statuam, dum vel hoc unicum in varias formas & effectus, vel etiam omnia alia ad eundem aspectum & effectum reducere possim; adeo ut si salia lixiviosa ex centum vel pluribus herbis parata ante oculos haberem, ullum sal, multo minus ullum subjectum ex quo ejusmodi sal alkali productum fuerit, divinare possit nemo. Quin nemo potest
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vel in genere cognoscere utrum ex esculento innocuo, an ex summe venenoso & maxime nocivo vegetabili confectum sit; subjectum ne suaveolens an graveolens, aut plane absque ullo odore vel fœtore fuerit; an sapidum vel insipidum; purgans vel adstringens; antiscorbuticum, epilepticum, vel antifebrile, emeticum, vel diureticum, narcoticum, vel sternutatorium, causticum, vel balsamicum; an ligna vel radices, cortex vel medulla, flores vel herbæ semina vel succi, vel quicquid fuerit, ex quo sal illud paratum sit. Existimo hæc iis convincendis sufficere posse qui adhuc constanter opinantur salia alcalina fixa specificam herbarum aliorumque vegetabilium ex quibus producuntur virtutem secum retinere; ita ut sal caryophyllorum & cinnamomi stomachicum, sal hyosciami & papaveris narcoticum, sal radicum jalappæ purgans, sal radicum tormentillæ vel corticum chinæ adstringens vel antifebrile, sal ipecacuanhæ & gratiolæ emeticum, sal esulæ causticum & sal cicutæ venenosum & lethiferum esset: quin & satis, opinor, dixi ad universos resurrectionis fratres ita confundendos, ut resurrectionem & revivificationem vegetabilium abjicere debeant, dum demonstrari potest omnia ejusmodi salia lixiviosa in toto regno vegetabili ad eandem figuram & effectum, imo ex eadem herba ad tam multiplicia salia reduci posse: unde aperte hic profiteor nemini hominum possibile esse ex cineribus vel lixivio ne quidem solam externam figuram istius vegetabilis ex quo parata sunt rursus producere, vel in sale ipso ex ejusmodi puris salibus repræsentare: de industria dico ex ejusmodi puris salibus; siquidem ipse non una vice vidi ejusmodi figuras herbarum ex teneris æneis & subtilibus linteis filis artificiose concinnatas, & in lixiviis concentratis impositas vel suspensas, ubi utique omnia ad ejusmodi fila circumcirca crySTALLISATA fuere, quæ deceptor ignaris tanquam veram resurrectionis plantarum repræsentationem commonstrabat: verbo, tota quæ prætenditur ab humana arte resurrectio in veritate non fundata, sed tantum chimerica imaginatio est, & non nisi in libris visibilis.

Reperitur etiam inter puriora & ad chymicos labores aptiora cognita fixa alcalica salia ipsa in hac vel illa parte quædam differentia, quæ vero itidem ab exercitato chymico omnia removeri, saliaque penitus æqualia & ad eandem figuram & effectum reduci possunt. D. Hoffmannus in libro 2. observat. phys. chym. selectiorum sub n^o. 29. totum caput hac de re consignavit, nihil tamen quam differentias ipsas observavit & protulit, quæ summam in his consistunt. 1. Si oleum vitrioli nitro fixo affunditur, tum sub effervescencia verus spiritus nitri vel aquæfortis exhalat. 2. Hoc vero nunquam fit si oleum vitrioli sali tartari vel cineribus clavellatis affundatur. 3. Quin & in his utrisque posterioribus rursus quædam observatur differentia, dum a sale tartari (ex affusione olei vitrioli) superficies nigricantem cuticulam acquirit, liquor ipse nigricans evadit, & plane alius fœtor quam spiritus nitrosi à nitro fixo deprehenditur. 4. Omnia autem hæc a cineribus clavellatis non observantur, dum ab iis nec spiritus nitri,

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nec cuticula, nec nigricans color seu solutio, sed iterum singularis vapor apparet. 5. Fumi hi nitrosi etiam manifesti fiunt, si oleum vitrioli sali tartari extemporaneo, quod ex 2 partibus nitri & una parte tartari paratur, affunditur. 6. Quod vero iterum non licet videre in ejusmodi sale tartari extemporaneo quod cum pauca additione nitri elaboratum fuit. 7. Ex sale tartari & arena vitrum clarum & pellucidum parari non potest. 8. Bene autem ex sale tartari extemporaneo, ut & ex cineribus clavellatis. 9. Ex sale tartari vel cineribus clavellatis in crucibulo fufis, adjectis carbonibus, resultat species hepatis sulphuris, quale tamen nec nitrum fixum nec nitrum causticum constituit. 10. Sal tartari & nitrum causticum cum spiritu vini rectificatissimo tincturam largiuntur, quam vero nec nitrum fixum, nec cineres clavellati, nec istud sal tartari extemporaneum, quod ex 2 partibus nitri & 1 parte tartari paratur, depromunt.

Has quidem differentias Hoffmannus advertit, sed non dixit unde hæc eveniant, qua in re differentia hæc sita sit, an & quomodo ista meliorari & corrigi queant, multo minus quomodo hæc adeo differentia ab ipso reperta salia alcalino-fixa penitusque æqualia reddi possint; cum tamen omnia & singula naturali ordine procedant, differentia non adeo difficulter percipi & facile corrigi & unum sal alteri æquiparari possit, adeo ut 1°. ne unicum quidem phænomenon ex omnibus supra allegatis uni vel alteri sali singulare existat, & 2°. inter omnia pura fixa alcalica salia nullum aliud discrimen amplius nisi circa gradus causticitatis adverti debeat. (a) Affusum oleum vitrioli in nullo dictorum salium singularem, sed semper eundem vaporem & foetorem producere debent. (b) Omnia hæc salia æqualiter in clarum & pellucidum vitrum redigi debent. (c) Singula etiam spiritum vini rectificatissimum pulchro colore tingere debent, & ita porro. Sic non mirandum est quod oleum vitrioli ex nitro fixo, vel ex sale tartari extemporaneo cum 2 partibus nitri parato spiritum nitrosum ejiciat, dum si hoc apparet in ejusmodi sale alkali necessario adhuc quædam nitri crudi portio inest; unde exundantes ex eo fumi (qui nihil aliud quam verum spiritum nitri constituunt) adeo naturales sunt ac si Glauberiana methodo oleum vitrioli nitro crudo affundatur, cum e contra utique ex sale tartari vulgari, ex cineribus clavellatis, aliisque ejus generis alcalinis salibus quibus nitrum non accedit, imo quibus non superflue accedit, etiam nullus spiritus nitri liberari vel fumus nitrosus expectari potest. Hæc res quo tanto certius pateat, recipiatur tantum idem nitrum fixum vel idem sal tartari extemporaneum à quo ab affusione olei vitrioli fumus nitrosus apparet, idque denuo cum uno vel alio subjecto inflammabili regni vegetabilis commisceatur, e. g. nitrum fixum cum majori carbonum quantitate, & sal tartari extemporaneum cum copiosiore tartaro conjungatur, & deflagret ut ante, vel majoris certitudinis causa proportio carbonum vel tartari adhuc plus augeatur, quo superfluum antea & adhuc crudum existens nitrum.

nitrum plus inflammabilis terræ reperiatur quacum incendatur & alcalifetur, ut per consequens nihil nitri crudi amplius restare possit, tum ex hoc relictis sale ab affusione olei vitrioli nullus spiritus nitrosus amplius, sed potius plane alii vapores effumabunt. Quod oleum vitrioli cum sale tartari foetorem spiritui nitri plane dissimilem, nigricantem cuticulam, & obscuram solutionem efficiat, hoc a nulla alia re nisi a superfluis adhuc in sale tartari residuis empyreumaticis partibus unice dependet; quod si sal tartari ab istis partibus decenti modo repurgatum sit, tum itidem nec foetor amplius, nec nigricans substantia, utpote quæ oleum vitrioli cum omnibus oleosis contrahit, apparebunt: unde ex cineribus clavellatis, quia calcinatione sc. ab oleo empyreumatico magis liberati sunt, ut & ex puro sale tartari, si sufficienter calcinatum est, ejusmodi nigredo nunquam apparet nec demonstrari poterit, sed ab affusione olei vitrioli omnia clara & albida permanent. Simili ratione hoc oleum empyreumaticum in sale tartari unica existit causa quare cum arena clarum & pellucidum vitrum non largiatur; simul ac superflua hæc oleosa substantia ipsi dempta fuit, tum æque aptum & commodum est ad pellucidum vitrum conficiendum ac cineres clavellati vel sal tartari extemporaneum ipsum: hoc confirmat quod sub ejus præparatione, durante detonatione cum nitro, omnis oleosa tartari substantia combusta & destructa est: unde hoc sal alkali, quamvis tartarus ad ejus præparationem accesserit, per consequens eodem modo vitrum clarum efficit ac cineres clavellati, ad quos nihil de tartaro assumitur. Quin etiam hoc in tartaro adhuc præfens, vel alio quoque modo sali alcalino conciliatum phlogiston, utpote quod tantum & unice ad causticitatem confert, est substantialis ista materia quæ spiritui inflammabili rectificatissimo tincturam conciliat; quanquam etiam ex parte spiritus ardens, qua menstruum, si nempe ille olei dives sit, non parum ad hoc contribuat, & tinctura tanto magis acceleretur & augeatur. Quid mirum igitur si ex sale tartari extemporaneo cum 2 & 3 partibus nitri parato (quippe per quod omne inflammabile & ad tincturam producendum absolute necessarium destruitur) nullam tincturam recipias?

Fixed alkalis compared with other chymical mixtures, and of their use in chymistry.

In definitione horum salium dixi ea consistere ex terra in quam parum vel aliquid fixioris vel ultimo magis concentrati salis acidi & inflammabilis, mediante igne, tostione quasi & affatione impactum est; PARUM VEL ALIQUID dixi, significare volens, superfluum sive acidum sive inflammabile, imo ipsas terrestres superfluas partes, non modo non necessaria, sed respectu puritatis & perfectionis quas ejusmodi sal requirit præjudiciosa & nociva esse. Quod si purum quoddam sal alkali fixum, sive de industria sive per accidens, cum satis notabili & aucta portione unius antedictarum constituentium partium, sive sit nimium acidi sive nimium inflammabilis, sive nimium partium terrestrium, vel cum duobus horum simul, denuo tractetur & commisceatur; tum novum hoc commixtum non modo aliam

aliam plane denominationem sortitur, sed & plane alias qualitates & effectus ac antea solum sal alcali habuit. Nam si sal alcali fixum cum sale acido tam diu commisceatur donec, post remissionem effervescentiæ & separationem aquæ, utpote quæ tantum pro vehiculo solutionis inservit, syrupum violarum si ejus aliquid admisceatur in colore non alteret, eumque nec rubrum nec viridem reddat, tum appellatur nova hæc mixtio sal medium, sal falsum, vel sal neutrum. Quod si acidum minerale ad hoc adhibitum fuerit, tum novum ejusmodi mixtum facile in crystallos concrevit; si vero acidum ejusdem vegetabile usurpatum fuerit, tum difficulter vel plane non crystallisari potest.

Cum autem in chymia valde distincta salia acida occurrant, proinde etiam juxta indolem istorum acidorum [si unum vel alterum eorum cum sale alcalino-fixo usque ad saturationem unitum est] exinde productum sal medium ordinariè denominationem accipit, e. g. 1. Si sal alcali fixum cum acido vitriolico seu sulphureo ita commisceatur ut crystalli exinde emergant, tum ex his utrisque obortum crystallinum sal medium plerumque tartarus vitriolatus, vel sal polychrestum vocatur. 2. Si sal alcali fixum cum acido nitri commisceatur & crystallisetur, perfectum inde nitrum crystallinum exoritur, quod nitrum regeneratum, vel etiam tartarum nitratum appellare consueverunt. 3. Si cum acido salis communis saturetur, fit inde sal commune regeneratum, ita dictum sal embryonatum vel digestivum Sylvii. 4. Cum acido aceti fit terra foliata tartari, seu sic dictum arcanum tartari. 5. Cum acido tartari oritur tartarus solubilis, seu tartarus tartarificatus. 6. Cum succo citri tartarus citratus. 7. Pars alcalina quæ in sale communiter residet cum acido vitriolico sal medium constituit quod sal mirabile Glauberi vocant. 8. Quod si pars alcalina nitri cum dicto acido vitriolico commisceatur, ita ut ex his duobus ingredientibus crystallinum sal medium paretur, illud, quanquam in fundamento à tartaro vitriolato nihil differat, aliud tamen nomen recipit, dum scilicet ab innumeris annis arcanum duplicatum, vel panacea Holsatica appellatur. 9. Si vero ordinariis alcalinis plantarum salibus tantum superfluum quicquam acidi, sive à parte vegetabilis ipsius sive aliunde accedat, tum communiter inde sal crystallinum plantarum lixiviosum oritur.

Si sal alkali fixum cum inflammabili quodam misceatur, sive sint pinguedines sive expressa, quin & certis sub enchiresibus destillata olea, exsurgit inde pro primo sapo, deinde vero etiam sal volatile & spiritus urinosus; quod si vero olei empyreumatici animalis quippiam accedit, tum hoc cum eo etiam tantum imprægnatum sal alcali præ inflammabili vegetabilium in curiosis quibusdam laboribus non parum sese distinguet. Si bituminosum & acidum vitriolicum mixta [nempe in sulphure communi] cum sale alcalino-fixo concurrunt, gignitur inde hepar sulphuris. Denique, si purum sal alkali fixum in igne cum terra saturetur pellucida, ut arena communi, silice, pyrite,

glarea, & similibus, tum non tantum subtilis spiritus acidus inde extorquetur, sed & totum mixtum convertitur in pellucidam & transparentem, in igne quidem adhuc fusibilem, in aqua vero amplius indissolubilem terram, nempe vitrum, vel etiam cum aliis additamentis in porcellanam.

In genere salia alcalia fixa non facile sese uniunt, vel hæc salia non facile quicquam dissolvunt, quod non vel inflammabilitatem vel aciditatem quandam continet, & unum semper lubentius & intimius quam alterum. 1. Sic salia alcalia fixa facile quidem dissolvunt sulphur commune, quippe in quo inflammabile & acidum unita occurrunt, verum facile quoque ab eo rursus separantur & liberantur. 2. Facile quoque dissolvunt & sese uniunt cum axungiiis, pinguedinibus & oleis expressis, & communicant pinguibus hisce materiis dispositionem sese cum ipsis prompte in aqua solvendi, & cum aqua sese uniendi, cum alias istæ absque alcali fixo unionem cum aqua omni modo fugiant & detrectent. 3. Salia fixa solvunt & uniunt se quoque tandem cum oleis destillatis essentialibus, quamvis paulo difficilior. Et eadem cum differentia horum jam memoratorum duorum generum oleorum, eorumque faciliiori vel difficiliori combinatione cum alcali, separatio quoque eorundem succedit, dum salia hæc fixa a pinguedinibus, axungiiis & oleis expressis perquam facile, & ab oleis æthereis vel essentialibus contra perquam difficulter vel plane non separari queunt, præcipue si semel intime cum iis unita & utraque in perfectum saponem redacta fuere. 4. Separatio ex vitris quidem tarde aliquatenus succedit, possibilis tamen est factu, quamvis in uno citius quam in alio (præ reliquis in vitro silicis omnium facillime) dummodo denuo cum alcali secundum artem misceantur & debito modo tractentur. 5. Cum salibus acidis hæc salium alcalino-fixorum unio & solutio fere omnium facillime & promptissime succedit, & quidem triplici modo; (a) Vel miscendo, si utraque simpliciter absque intermedio jungantur; (b) Vel præcipitando, si vel (α) sal acidum, vel (β) sal alcalinum fixum antea cum alio quodam corpore commixta fuerint; (c) Vel etiam absque præcipitatione, dum modo sal acidum itidem antea cum alio quodam commixtum fuerit; sed hoc in acido solutum per præcipitationem exinde non separatur. 1. Miscendo peragitur hæc unio si sal alkali fixum in aqua solutum, vel etiam quod per se in deliquium abiit, cum spiritu vel liquore quodam acido confundatur, prout in elaboratione diversorum supra adductorum salium mediorum videre licet, e. g. in præparatione terræ foliatæ tartari, tartari tartarifati, nitri regenerati, tartari vitriolati ex spiritu vitrioli & oleo tartari per deliquium, &c. 2. Præcipitando absolvitur hæc unio (α); si sal acidum antea cum quodam (A) metallico, vel etiam (B) animali combinatum & solutum fuit, id quod multiplici ratione, vel per accidens vel de industria, fieri potest, & in chymia pharmaceutica sæpius occurrit. (A) e. g. in præparatione auri fulminantis, in qua si sal alkali solutum in aquam regiam auro soluto imprægnatam

imprægnatam infundatur, unio salis alcalici cum utrisque acidis (scilicet nitri & salis) cum prostratione auri contingit. Porro apparet hoc in præparatione mercurii præcipitati albi, in elaboratione tartari vitriolati Tachenii, & aliis metallicis præcipitationibus permultis. (B) circa animales solutiones videre licet ejusmodi unionem salis alcalici cum acido itidem præcipitando factam, e. g. in præparatione magisterii cornu cervi, aliarumque partium animalium. (β) Alia ex parte peragitur hæc unio modo præcipitationis, e. g. in præparatione sulphuris antimonii sic dicti aurati, in qua sal alcali primum solutis sulphureis partibus imprægnatum deprehenditur, quod tum cum affuso sale acido sese unit, solutum vero antea sulphur præcipitando deserit; dispalescit hoc porro si commune smegma in aqua solutum cum acido præcipitatur, & hoc fit ubique ubi crasse pingua, resinosa vel sulphurea cum sale alcalino fixo antea soluta & combinata fuere, postea vero cum acido præcipitantur. 3. Tertia methodus unionis quæ absque præcipitatione nec tamen simpliciter miscendo absolvitur, dum adhuc intermedium quoddam simul adest, duplici modo fieri potest; α. Vel si sal acidum antea cum sale volatili urinoso combinatum, & in sal ammoniacale redactum fuit, ubi, si huic sali volatili medio sal alkali fixum adjungatur, sal acidum, præcipue si lenis tantummodo calor applicetur, repente novo huic adveniienti alcali fixo sese associat, & deserit sal alcali volatile quod antea continebat, quod tum dicto leni calore tanquam desertum & in se perquam volatile corpus facile expelli potest; β. Vel sistitur etiam hic unionis modus, si sal alcali antea cum debiliore acido ipso combinatum fuerit, fortius acidum affundatur, & hoc novum mixtum in retorto vase igni exponatur: tum enim debilius acidum cogitur absolute fortiori cedere, & destillando separatur: quod in destillatione spiritus nitri & salis fumantis aliorumque luculenter patet. Quanquam autem hæc salis alcali fixi cum omnibus salibus acidis combinatio perquam amice quasi peragitur, inde tamen non existimandum ac si cum omnibus æqualiter contingat, vel cum uno eodem modo ac cum altero æquali firmitudine sese uniat. Minime; sed & hac in re ingens occurrit differentia, dum in uno vel altero præferentia (ut barbare loquar) seu propinquior affinitas, vel prout cuilibet denominare placet, inter sal alkali fixum & hoc vel illud sal acidum observatur. Et cum hæc affinitatis scala in chymia non parvi emolumenti, ejusque notitia chymico practico perquam necessaria sit, proinde de ea, iis præcipue quibus ista adhuc forte ignota est, quædam in medium proferre superfedere non possum, præprimis cum ex combinatione salis alcalino-fixi cum salibus acidis, & ex scala ista quam jam producturus sum, major vis & fortitudo unius acidi præ altero omnium optime annotari & dijudicari possit, nempe in quantum ad combinationem cum alkali fixo sese refert.

Purum ergo sal alcali fixum omnium optime & firmissime sese combinat cum fortissimo præ omnibus acido primigenio, puro puto & fixiore acido vitriolico & sulphureo: quod si hoc acidum adhuc

cum principio inflammabili, ut communi sulphure, commixtum prodit, tum intima ejusmodi unio cum alcali non celebratur, sed superficialis tantum solutio seu cohæfio emergit, & fit nudum hepar sulphuris, ex quo alcali facillime, imo cum debilissimo acido vegetabili rursus separari potest. Bona ex parte firmius acidum hoc sulphuris sali alcalino cohæret, ut ad minimum a debilissimo acido liberari non possit, si portionem tantum inflammabilis quocum conjunctum fuerat per deflagrationem amisit; quod clare satis patet si durante deflagratione sulphuris sal alcalinum fixum ea ratione applicatur ut volatilis spiritus sulphuris ei intricetur & irretiatur; interim tamen cohæfio hæc non est satis firma, dum volatilis hic spiritus per propriæ quoque indolis, purius tamen, ab inflammabili plane depuratum, & magis fixum & concentratum, acidum vitriolicum rursus inde expelli, & à sale alcalino fixo liberari potest; ex alia ratione nulla quam quia bona ex parte adhuc de principio inflammabili participat, ex quo acidum istud adhuc volatile & subtile, per consequens non ita purum & fixum existit ac oleum vitrioli rectificatum; si vero ejusmodi spiritus sulphuris volatilis tantum per aliquod tempus libero aëri exponatur, tum tenerum hoc inflammabile plane dissipatur & exhalat, restante è contra itidem puro, fixo, & cum alio ex vitriolo vel alumine destillato in omnibus probis æquali & in nulla re diverso acido, quod tum cum sale alcali fixo eadem ratione ac aliud purum, fixum, acidum vitriolicum sese quam firmissime commaritabit. Post hoc acidum sulphureum vel vitriolicum unit sese nostrum sal alcali fixum lucentissime cum acido nitri, seu spiritu nitri. Et post hoc cum acido salis communis seu marini. Denique omnium debilissime cum acidis vegetabilium, ut acido aceti, tartari, spiritu lignorum, spiritu sacchari, succo citri, vino Rhenano, &c.

Ex his igitur sufficienter addisci potest, qua ratione novæ semper combinationes salis alcalino fixi cum sale acido perpetrari, & idem alcali aliquoties debiliore acido per fortius rursus surripi possit, ubi autem in scala hac non deviandum est. Nam si sal alcali fixum cum puro acido vitriolico combinatum foret, tum utique nullum acidum ex omnibus aliis potens esset hoc sal alcali fixum ipsi rursus eripere, quia nimirum hoc est fortissimum omnium, & omnia reliqua acida sunt multo debiliora, utpote quæ singula contraria ex parte ab acido vitriolico separari possunt. D. Stahl quidem medium quoddam demonstravit quo sal alkali ex acido vitriolico rursus liberari possit: verum hoc non fit mediante alio acido, sed mediante additione principii inflammabilis, paucis per artificiosam sulphuris formationem, per consequens requisito ad hoc labore in igne. Laudatus D. Stahl hunc mihi anno 1718. cum Lutetiæ Parisiorum adhuc degerem, singularem honorem exhibuit ut hujus liberationis causa novum plane problema, ad istam sulphuris genesin plane non applicabile, in considerationem & solutionem per literas mihi proponeret; continetur autem sequentibus verbis: qua ratione sal alkali fixum ab acido vitriolico,

prout

prout utraque sub figura crySTALLINI tartari vitriolati apparent, in sola cavitāte manus & unico in momento liberari possit? D. Geoffroy senior cui problema hoc communicavit anno 1720, in historia academīe scientiarum Gallicae illud imprimi curavit, & putativam hujus problematis solutionem annexit; sed penitus aberravit dum desideratam hanc salis alcalini separationem de formatione sulphuris diu jam cognita & publice nota explicat; hæc vero sulphuris productio plane non in unico momento, multo minus in sola cavitāte manus, sed in crucibulo igne candente fit.

Circa combinationes præcipitatorias in quibus metalla soluta fuere adhuc observandum est, quod sal alkali fixum, durante unione cum acido, cadenti ad fundum metallo alterationem quandam imprimat, quæ non raro tantam mutationem involvit ut talia cum ipso præcipitata metalla perquam difficulter in pristinam malleabilem & fluxilem, seu fusibilem metallicam formam reduci sese patiantur; cujus rei (ut aliquid tantummodo adducam) etiam ferrum quod ex commixtione vitrioli martis cum sale alcalino-fixo, in præparatione tartari vitriolati Tachenii, ad fundum cadit sufficiens testimonium perhibent.

Solent etiam nostra salia alkalina fixa præter memorata superius corpora, per se adhuc diversa corpora metallica solvere, quanquam pro hac intentione aliqualis causticitatis gradus requiratur. (a) Solvunt proinde calcem plumbi, vel etiam plumbum tenerè rasum. (b) Solvunt itidem subtilem rasuram cupri, vel etiam cuprum è vitriolo præcipitatum, quin & cuprum in viridi æris contentum. (c) Sic & stannum solvunt; (d) Ut & regulum antimonii, cum quo in calcem, imo etiam ultimatim, si fortissime igne torquentur, plane in succinei coloris vitrum convertuntur. (e) Ferrum solvunt duplici ratione; (1.) Vel dum cum nitro detonatur, & nitrum causticum ejus ope producitur; (2.) Vel etiam si puram solutionem salis alcali fixi solutioni martis cum spiritu nitri antea factæ infundas, prout hoc fusius in dissertatione quadam sub D. Stahlio de hac materia evolvi potest. Quod si vero fixum nostrum sal alcali antea sulphure bene imprægnetur, tum omnia metalla, (quædam etiam semi-metalla) nimirum cuprum, ferrum, plumbum, regulus antimonii, imo etiam stannum & aurum cum ipso dissolvi possunt. Denique, salia alcalino-fixa salibus alcalino-volatilibus siccam consistentiam conciliant, quod corpora alcalino-terrea non faciunt.

Solvunt etiam hæc fixa salia tam ex spiritibus urinosis quam ex spiritibus inflammabilibus quoque superfluam & superficie tenus tantum adhærentem oleosam substantiam.

VIII. **I**N burning a white oak tree of two foot diameter, at Cambridge in N. England, which was about one third rotten, the decayed part turned almost into a good white alkali, running into hard, white and clean lumps; one of which was brought us at college to know what it was. We tasted it and found it to be salt

A large quantity of alkalious salt produced by burning rotten wood. By Mr. and

Robie. Com-
municated by
the Rev. Mr.
Derham.
n. 366. p. 121.
Sep. &c. 1720.

and very strong. We dissolved it in clean water, and upon decantation and evaporation without any filtration, it produced a very clean, white salt, exceeding in strength and whiteness any to be bought at the shops. Now although alkalis may be extracted from common ashes, yet what is peculiar in this is, 1. That the rotten wood itself melted while burning, and run down into hard lumps of salt; but none of that which was sound did so; and what was most decayed yielded the greatest quantity of salt. 2. Whereas all other alkalis made from wood by incineration are blackish at first, and a lixivium made of them, although often filtered, will yet be tinged with a brown colour, occasioned from a kind of coal or ashes so closely united to the alkali in burning as not easily to be separated by filtration, tho' often repeated; this alkali was very white, even before solution, and when dissolved the lixivium was not in the least tinged, but clear like pure water, only a very small quantity of ashes subsided to the bottom of the vessel in which the solution was made. The lixivium thence decanted needed no filtration, but when boiled up to dryness the salt remained fine and white. 3. As the heat of the fire grew more intense the wood did, as it were, melt and clodder together in great lumps, visibly bubbling and boiling with an hissing noise, like the frying of fat in a pan. 4. Whereas the weight of the alkali salt produced from other wood in the common way of incineration is very inconsiderable, in proportion to the weight of the wood producing it; this salt nearly equalled in weight the wood from whence it was taken. 5. Whereas the ashes of other wood are never so replete with salt as that it can be seen, or in the least cause the ashes to lump or clodder together; the whole of this would gather into hard and solid white lumps as easily to be distinguished from ashes (tho' white) as the purest salt of tartar made with nitre. 6. Although from other rotten wood much less of an alkali can be produced than from sound wood, here it is quite contrary; the decayed part of this tree yielding very largely, but the sound part no more than other wood.

This tree was probably struck with lightning many years ago, it being torn from the top of its trunk to the bottom on that side which is now decayed and which yielded the aforesaid salt, having a channel about five inches wide at first, as we judge, which length of time had closed; and under this bark the wood was black, caused we suppose by the lightning. From these things we conjecture that the wood having been by this means long exposed to the air and water was thereby rotted; and that the lightning had so altered and disposed its parts and pores (their figure and texture appearing much different from other rotten wood) to attract and retain the nitrous salt of the air, which through so long a space of time could not but be in great abundance. Just as salt of tartar, or other alkalis exposed to the air for some considerable space of time, will be wholly reduced

to a nitrous salt, as Glauber says, and its quantity also increased very considerably. If it should be objected, that the nitre being volatile would fly away in burning; we answer, that although nitre can't be fixed and reduced to an alkali salt by calcining it per se; yet it may by the addition of powder of charcoal. And we suppose the wood in which this nitrous salt was lodged so altered by lightning as to serve instead of coal in the burning of it.

IX. 1. **T**Hat the salt of late years distinguished by the title of sal catharticum is made from what at the salt-works they call bittern is pretty commonly known; but the particular manner how this bittern is produced, and from it these salts, has not yet, that I know, been communicated to the world in such a manner as to be intelligible. And the opprobrium unjustly cast upon the salt, of its being a counterfeit Epsom salt, or common salt dissolved and recrystallized, has very much sunk its esteem among the learned in physic. By M. Bolduc's account, in the history of the royal academy of Paris for 1718, I find he did not succeed in the experiments he tried to discover what this salt was made from, justly grounding his opinion of its not being all made from the Epsom waters, or other springs that afford bitter purging waters, on the large quantities consumed and its low price. After all his curious endeavours it still remained a secret, till he received the following imperfect account from hence by Dr. Mendez. It comes, says he, from Lemington and Portsea, both in Hampshire, where from heaps of fossile salt there runs a saltish, bitter, sharp, and pungent liquor. One would judge by its brackishness and bitterness that it contained two kinds of salts, the one a sea salt, the other a bitter salt. To separate these they cause this liquor to run through hollow drains on the ground, where it condenses into salt; this they put into a large vessel with a great quantity of common water, and having boiled it till it is dissolved, they let it settle for several days. The water impregnated with the sea salt, which is the heaviest, sinks to the bottom of the vessel together with the earthy parts; and the water impregnated with the bitter salt, which is the lightest, swims at top. They take off this upper liquor as long as it retains its bitter taste without any pungency; afterwards they boil it in one or two waters, then evaporate it, and it yields white and transparent crystals which are the counterfeit Epsom salts. What experiments M. Bolduc made with the bittern sent him by that gentleman I do not remember to have read in any of the succeeding memoirs. Dr. Seipp, in his description of the Pyrmont waters, p. 127, says that the common English purging salt, which is sold in great quantities in Germany under the name of Epsom salt, is not prepared from the Epsom waters, but is made in London from common sea salt and oil of vitriol. In the same page he says that the salt obtained from the Pyrmont waters will part with its own acid spirit upon pouring

*Observations
and experi-
ments on the
sal catharti-
cum amarum;
commonly cal-
led the Epsom
salt. By Mr.
J. Brown.
n. 377. p. 348.
May &c. 1723.*

ing on the ol. vitriol. which the sal mirabile and the English purging salt will not. By this means he distinguishes the first salt from the two last. Dr. Quincey, in his *prælectiones pharmaceuticæ*, published since his death, says there hath lately been contrived a salt from the mineral purging waters, made by evaporation, filtration and crystallization. It was first entitled sal mirabile, or sal catharticum amarum; but it is now so scandalously counterfeited that it is little else than common salt dissolved and recrystallized.

Before I enter into the account how this salt is made, it may not be amiss to say something of the genuine salt made from the bitter purging waters, which the learned Dr. Grew first attempted at Epsom. Some years after several other bitter purging springs were found in different counties, and salts in small quantities were boiled up from them, but from no place, nor all the places put together, in such large quantities as from the springs on one side of Shooters-Hill in Kent about the year 1700, which were then in the possession of those two ingenious chymists, Mr. G. and Mr. F. Moulton; and where they made such a large apparatus for evaporating the water that they have sometimes boiled down 200 barrels in a week, from which, in a dry season and when the land waters did not get into their drains, they have obtained 224 pounds of salt. After these works had gone on for some time Dr. Hoy found out a more expeditious way of making a purging salt so nearly resembling the former in all its properties, that it soon passed on the world for it, and continued so to do. The great consumption of these salts (which then went only by the name of Epsom salts) as well at home as abroad, engaged some of our physicians (many years before M. Bolduc took notice of it) to suspect that even what was made at Shooters-Hill was spurious, and received an addition of something to encrease the quantity. But these suspicions, I dare positively affirm, were entirely groundless as to the salts made there, and I readily believe the same of any other place where the spring waters were boiled down for salt. But considering that there were greater quantities of this salt consumed than all the places where the waters were boiled could produce, which was the real fact at that time of day, there was sufficient room to suspect that some of them were not genuine, as appeared to be true some time after. For the secret, which was then in a few hands, of making these salts cheap gave those who had it an opportunity of under-selling those who made it from the waters, and in a year or two rendered them incapable of making it to any advantage. So that the work on Shooters-Hill was thrown up, and I believe there has not been 100 pound of salt made from the waters since that time in any part of the kingdom. Before this work at Shooters-Hill was broke up some pains was taken to discover the secret of those who sold the salt so cheap; and upon examining the several salts that were sold about town, those disposed of by Mr. G. and Mr. F. Moulton were certainly genuine, and were therefore

therefore a proper standard to judge of the rest. But from all the experiments then made there could no material difference be found between the salt made from the waters, and that made by them who were in the secret. There was indeed a salt sold by some, which in the course of those trials was found to be a *sal mirabile* made from the *ol. vitrioli* and common salt, but shot into such small crystals as not at first sight to be distinguished from the other. It was not long before the secret was discovered, and the experiment was tried at the Lady Carrington's salt-works near Portsmouth; where it was found the same thing could be done as at another work not far from it in which Dr. Hoy had been concerned. It was some years after this before the salt-makers at Lemington attempted to make it, or indeed knew the method; tho' they are now the greatest traders in it, and have sent several tons in a year to London, besides what has been directly exported from thence. I remember it to have been the opinion of the proprietors of the salterns near Portsmouth, that this purging salt could not be made at any other salt-works except theirs, and that the bitter taste in the salt was communicated from the earth to the sea water whilst it stood exposed in their sun pans. But time has proved this opinion false; for besides what has been said of its being made at Lemington, it was about 4 or 5 years ago begun and still continues to be made near Newcastle, and doubtless may be made at any other salt-works where the common salt is made from sea water by evaporation. There is some difference in making the common salt in Hampshire and about Newcastle: at the first of these places in the beginning of the summer at spring tides, or at new and full moon, the sea water is let into their feeding ponds, which are their reservoirs for the summer's working, and from thence is conveyed into small square pans, and again after some time from these it is conveyed into larger pans or beds, which they call brine or sun pans; all which are made of sea-mud and earth. In these last pans or beds it lies exposed to the sun and wind, in order to exhale the weakest waters; and it is in these beds, if the weather prove very favourable, that they can make as good bay-salt as any we have from France, and at such a time they never bring their brine to the boilers. But if the weather is not hot enough for that purpose, their brine continues exposed till it becomes of such a strength as to support their eggs, made of glass or wax, to a certain height above the surface of the brine, which from thence is conveyed into large store-cisterns, and then into iron pans, where it is boiled down (after having been frequently scummed) to a sea salt. 'Tis observable that whilst the brine is boiling there precipitates a hard crusty matter, which is partly taken out by vessels placed in proper parts of the pan for that purpose, and partly fixes on the bottom of the iron pan so hard as to be afterwards dug off; and this the workmen call *scratch*, and is what Dr. Collins in a transaction † concerning the sea water boiled at Shields, calls a *stone powder*. When

† Vid. Vol. II.
C. II. § XLVII

the operation for the sea salt is finished it is taken out hot and put into wooden troughs with holes at the bottom, through which runs the superfluous liquor: under these troughs are set other vessels (with sticks fixed in them in a perpendicular posture) to receive what run through. In these vessels the liquor is suffered to continue some time, and according to the quantity of sea salt still left in it will crystallize to the sticks something like sugar-candy but in much larger shoots; and this they call cat-salt or salt-cats, and it holds some share of the bitter salt. When this salt is broke small, or rather powdered, it is so white that some gentlemen chuse it for their tables; but the greatest consumption of it is among the cake soap-boilers. The liquor that will not shoot to these sticks, is what at these works they call the bittern, of which is made the sal catharticum.

*Continued by
the same.
n. 378. p. 372.
July &c.
1723.*

IX. 2. **N**EAR Newcastle their method is to receive the sea water into their reservoirs at high water, at any time of the moon, if there be no fresh in the river occasioned by rain in the higher country; and from these reservoirs, without exposing it in beds as at Lemington, they pump it into their boiling pans, where evaporating it almost to a pellicle they fill it up again eight or nine times, and then waste it with a gentle heat for the common or sea salt. The liquor that runs from this salt, when taken out and put into proper vessels, is what they call the bittern; which if it stands some time in those vessels a salt will shoot and crystallize to the sides, in taste pretty much like sea salt, but with a degree of bitterness, and seems to answer to the cat-salt of the Lemington works, and very probably would shoot after the same manner if they used the same apparatus.

I could not but mention this general and loose account of making the common salt, as necessary to introduce the liquor called bittern; which, before Dr. Hoy found out an use for it, was always flung away; being so different in its properties from the brine from which the sea salt is produced that it would not boil up into a sea salt again, and required the nicest skill and attendance of the operator to determine the time when to take out the sea salt from the pans before the bittern incorporated with it, which would otherwise spoil the whole making. The bittern at Lemington, as observed before, not shooting to the sticks is carried by channels into pits made tight with clay, where it stands for some months and there will shoot again: what liquor remains is boiled down till it is observed to be in a disposition to crystallize, and then is conveyed into wooden coolers lined with lead: the liquor which will not shoot there is boiled down after the same manner in order for another crystallization. By this time the liquor seems to have altered its property, and becomes of a very pungent biting taste, and if boiled down will no longer shoot into crystals as before, but precipitates during the boiling a small grained salt; and if you should continue to boil down the liquor separated from

from this salt, each quantity of salt thus produced will still be more pungent than the former. If you boil down the whole quantity of this liquor, it will produce a salt which exposed to the air runs per deliquium. But as this salt is not the business of our present enquiry it may probably be the subject of another paper. At present I can give no other name to it, than a third salt produced from the sea water, differing in some respects as much from the other two as they differ from one another. The liquor that produces this salt is always flung away where-ever the *sal catharticum* is made.

To return to the several crystallizations mentioned to be shot from the bittern; they will be different as to their figures, and hold some share of the third salt but now taken notice of, which makes them apt to give and dissolve; nor is their taste come yet to that simple bitter of the pure salt. They are therefore either separately or all together to be flung into a copper, with as much common water as is sufficient to dissolve them and allow of a gentle evaporation, till they are again ready to be poured into the coolers in order for crystallization. This generally proves to be the pure *sal catharticum*, thoroughly freed (as far as the experiments I have tried can discover) from either a sea salt or the third salt. The liquor decanted from this shooting may be boiled down again in order for a second shooting, and after that a third; but as the liquors from these shootings are boiled away more or less, so you will sooner or later meet again with the pungent liquor which contains the third salt, as you did in the former shootings from the bittern, from which the pure *sal catharticum* must as carefully be freed as from the common salt. Of this the *ol. vitriol.* is the surest test, for it will certainly ferment with this salt if the sea salt has not been well separated from it, or if it still holds some of the third salt; and when any of the crystallizations will not stand this trial, they ought to be dissolved and shot again, as before, by which means the pure salt is to be obtained. I do not mention this experiment as used at the salt-works, but what I have found to be true in fact. It will also serve to distinguish a *sal mirabile* made at these works from that made with *ol. vitrioli* and common salt. The account they give of it is this. They take any quantity of coarse grained crystals boiled from the bittern, which when dissolved and evaporated, more than they would otherwise do for making the *sal catharticum*, they throw into a wooden bowl with some oil of vitriol, where it stands for ten days and shoots into large crystals, transparent, and like the *sal mirabile*: but as the salt is not by this method sufficiently satiated with the *ol. vitriol.* (if they use any) so it is easily discovered by the *ol. vitriol.* which will readily ferment with it; whereas it has no effect on the other *sal mirabile* made as above.

By the assistance of my ingenious friend, Robert Cay Esq; at Newcastle, I have received the several shootings of salts from their bittern,

as also some of the bitter itself; from each of which I have obtained a pure *sal catharticum*, and also the third salt, as mentioned from the Lemington bitter. The method I took is agreeable to that I have already mentioned, and many years ago tried at the salt-works near Portsmouth. I am informed by Mr. Cay that they sometimes boil their bitter without letting it stand any time to shoot of itself. The difference is not very material.

If this account be intelligible, what the *sal catharticum* is will no longer be a mystery. And the next thing worth enquiring into will be, whether this salt deserves the reflections that have discouraged the prescription of it? and why it may not pass for a salt as excellent in its kind, and be of the same nature and have the same properties as that produced from the Epsom or any other bitter purging springs? To prove it to be so I shall give a very short abstract of what Dr. Grew says of his salt, and then observe how nearly the two accounts agree. The Doctor † says that a gallon of any of the bitter purging waters evaporated yields a cremor at top, as also a sediment, both together weighing 6, 8, or about 10 drams; and that the lesser part of the sediment is in substance the same with the cremor; the rest is all salt, but consists of two sorts, one a muriatic salt, the other peculiar to these waters. In the Epsom water the muriatic salt is about a 20th part of the saline mixture; in the Dulwich it is in a greater proportion, as also in several others; it is both in its acrimonious taste and figure of its crystals not unlike common salt. The other salt is that which he says is proper to the purging waters, and is made by evaporation and crystallization. In this preparation first the earthy or plaistery part is to be separated, next the muriatic salt, and lastly a brown and dark liquor from the proper salt of the waters. And † having shewn the difference of figure betwixt the crystals of this salt and those of alum he goes on, neither is there any better ground to account the purging salt a species of common salt, from which being perfectly freed it differs as much in taste as from alum. And, it will appear that the bitter purging salt, although it hath some qualities in common with other salts, yet is specifically different from them all. Thus far Dr. Grew.

Now I cannot see any thing in this account but what will, *consideratis considerandis*, very well agree with the purging salt from the sea water. For first, there is an earthy or plaistery part contained in these waters, and this must be separated. The very same is in the sea water, and is precipitated in the boiling them down, as has been observed, and by the operators is called *scratch*. Next there is a muriatic salt allowed to be in these waters; in some more, in some less, and this is likewise to be separated: the very same is done from the sea water, though in a vastly larger proportion. And, lastly, there is a black and dark liquor to be separated; though this is but a dark

† De nat. sal. cathart. amar. cap. 2.

† Ibid. cap. 4.

way which the Doctor makes use of to express himself it cannot be better explained than by what has been found to be fact in boiling down the waters at Shooters-Hill: viz. that after several shootings of salts by repeating the boilings of the waters, there would at last remain a liquor of a deep brown colour which would no longer yield a crystallized salt; but if boiled up dry would afford a salt of the same kind with the third salt already mentioned: and this explaining Dr. Grew's black and dark liquor helps at the same time to prove, in this article too, that the sea water affords the same kind of third salt. I have tried several of the Doctor's experiments by which he distinguishes his salt from other salts. Such as not affecting the colour of syrup of violets; curdling of milk when boiled; the figure of its crystals; its easy dissolution in the same quantity of water; its coagulating with the ol. tartar. per del; its calcination, and the bitterness of its taste, as well before as after calcination, &c. and find this salt thus separated from the sea water answer to all the trials. Some few experiments that the Doctor has not taken notice of I shall here subjoin, and then leave the whole to the opinion of better judges; whether there be any specifical difference between these two salts?

In order to have a standard for these experiments, I got Mr. Hyet apothecary at Epsom (whose fidelity I could depend on) to boil me down some of their waters, which he did from the well in the town, and sent me a sufficient quantity of the salts to answer my purpose. I procured likewise some of the first salts from the Lemington bitter: these do not hold so much of what I distinguish by the name of the third salt as I find the Newcastle salts do. This Lemington salt for distinction, I call the first Lemington salt. Part of this I dissolved and shot into pure sal catharticum, being freed as well from the sea salt as the third salt; and this I call the second Lemington salt. I procured likewise from Newcastle the first salts shot from their bitter, which I call the first Newcastle salt. Part of these I likewise dissolved and shot, and obtained a pure sal catharticum, and this I call the second Newcastle salt. I am obliged to make use of the sal mirabile made from the ol. vitriol. and common salt, that having been taken for the sal catharticum; as also of common salt, that having been represented as the principal substance of the sal catharticum. I took half an ounce of each of these salts, and dissolved them in about two ounces of water to each half ounce of salt. A small quantity of each dissolution I poured into as many glasses, and dropt into them all some butyr. antimonii. The precipitation that followed seemed to be alike in them all; and upon dropping a little ol. vitriol. into each, what was precipitated being more powerfully attracted by the oil, the several liquors became clear. These are the two only experiments in which I found the consequences so much alike in them all.

In the following experiments the *sal mirabile* is sufficiently distinguished from all the rest. Slices of gall cut into these several solutions have no manner of effect upon any, except that of the *sal mirabile*, which is soon tinged of the colour of sack, or rather deeper. *Sp. sal. arm. c. tart.* dropt into the several solutions turns them all milky, except that of the *sal mirabile*, which keeps its transparency. The *sp. salis armon. c. calce. the ol. tart. p. deliq. the tinctura coccinel. in sp. vin. fact.* do every one, used after the same manner, sufficiently distinguish the *sal mirabile* from all the rest.

In the following experiments the Epsom salt, the second Lemington salt, and second Newcastle salt, agree together, and differ from the common salt, the first Lemington salt, and first Newcastle salt. Into the several solutions I dropt a solution of silver in *aq. fortis*, from which followed these consequences. The solution of the Epsom salt, second Lemington salt and second Newcastle salt became equally milky before the precipitation. The solution of the sea salt and first Newcastle salt let the precipitation pass without receiving any milky tinge. The first Lemington salt, as holding less of the third salt than the first Newcastle salt did, took a little milky tinge. The precipitation fell nimbly thorough the solution of the *sal mirabile* leaving it milky. In the condition these were in I poured some *ol. tartar. per deliq.* to each of them, whereupon after some time a blueish scum arose on the surfaces of the Epsom salt, second Lemington salt, and second Newcastle salt: there likewise appeared a little on the first Lemington salt, but none on the rest. A solution of corrosive sublimate was made in water, ten drops of which mixed with the several solutions produced little or no alteration; but upon dropping in the *ol. tart. per deliq.* the following appearances were produced: in the solution of the Epsom salt, second Lemington salt and second Newcastle salt the precipitations were red; in the solution of the common salt and first Newcastle salt the precipitations were white; in the solution of the first Lemington salt the particles precipitated approached pretty near the colour of the three first. I took some of these several salts in substance and to each of them poured a little *ol. vitriol.* which is one of the experiments Dr. Grew tried upon his salt, and which he says causes a moderate ebullition, whereby it appears to partake of an alkaline principle: but without looking for this alkaline principle from its fermenting with an acid (terms justly exploded by the learned Dr. Freind in his *Prælectiones Chymicæ*) I am inclined to believe that the salt on which he tried the experiment had not, according to his own directions, been thoroughly separated from his muriatic salt. For this oil poured on the Epsom salt, second Lemington salt and second Newcastle salt produced no sensible fermentation. On the sea salt it acts with violence, forcing off its acid spirit with an insufferable gas. The same effect in proportion it had on the first Lemington salt and first Newcastle salt; none at all on the

the sal mirabile, as being a sea salt already satiated with the oil. What I have all along called the third salt, answers in most of these experiments to the sea salt, and yet has some properties exceedingly different from it: to those I have mentioned these may be added; it will not decrepitate like sea salt; it readily melts when put in a crucible in the fire; when calcined till red-hot it affords a calx equal to if not stronger than a limestone, and ferments violently as well with water as with ol. vitriol. This calx exposed to a moist air will partly run per deliq. but not so soon as before calcination. All these properties differ in every respect from those of the common salt, and leave me still in doubt what to call it, as also how far experiments of this kind may be deemed conclusive.

X. **D**R. Douglas having lately given an account (from the history *Of the quantity of resin in the cortex eleutheriæ. By n. 371. p. 81. Apr. 26. 1722.*) of the royal academy at Paris) of the cortex eleutheriæ; and among other things having said that M. Boulduc had from one ounce of the bark, by means of spirit of wine, got 5 drachms of resinous extract, there remaining 3 drachms of fæces; and that gentleman's account of some of the properties of this bark being founded on the quantity of resin supposed to be contained in it: I proposed to Dr. Douglas and some other gentlemen of the society (who agreed with me in believing that scarce any part of any plant would yield that quantity of resinous extract) to try the experiment.

I took two ounces of picked bark and digested it in rectified spirit of wine, which was often decanted and fresh spirit put on until the bark would yield no more tincture. The impregnated spirit being evaporated by a very gentle heat there were left two drachms of resinous extract; the remains of the bark dried weighed one ounce two drachms and a half; the loss this way is three drachms and an half. I boiled these remains in several waters until they would no longer tinge the water, which being evaporated yielded one drachm and an half of extract; the remains of this dried weighed one ounce and half a drachm; the loss by this method is half a drachm. I took two ounces more of picked bark and boiled it in several waters till the bark gave no more colour; and then evaporating the water had two drachms of extract. The remains being dried weighed one ounce six drachms; here the loss was not any thing, except so much as might answer to the quantity of the menstruum left in the extract, which allowance must likewise be made in the other extracts. I digested the remains in rectified spirits of wine until they no longer tinged the spirit, and by a very gentle evaporation I found remaining one drachm of resinous extract. What was left, when dried, weighed one ounce two drachms and an half; in this the loss was two drachms and an half.

The difference in the quantity of extract obtained by these two different methods is but half a drachm, and the medium between them, upon putting together the several extracts made with spirit of wine:

wine and water, is in the whole but three drachms and a quarter. But the extract made with spirit of wine alone is no more than two drachms from two ounces of the cortex, instead of ten drachms which it ought to have yielded according to M. Boulduc.

*A new sort of
molosses made
of apples. By
P. Dudley Esq;
n. 374. p. 231.
Nov. &c. 1722.*

XI. **T**HE apple that produces the molosses is a summer-sweeting, of a middling size, pleasant to the taste, and full of juice, so that seven bushels will make a barrel of cyder. The manner of making it is thus: they grind and press the apples, and boil the juice in a copper till three quarters of it is wasted, which requires about six hours gentle boiling; and by that time it comes to be of the sweetness and consistency of molosses. Some scum the cyder as it boils, others do not, and yet there seems to be no great difference in the goodness of the molosses, which answers all the ends of that made of the sweet cane imported from beyond sea. It serves not only for food and brewing, but is of great use also in preserving cyder; two quarts of it put into a barrel of racked cyder will both preserve it and give it a very agreeable colour. The apple-molosses was discovered a few years since by Mr. Chandler at Woodstock in N. England, a town remote from the sea, and where the W. India molosses is dear and scarce: he ingenuously confesses the discovery was purely accidental; but ever since he has supplied his family with molosses out of his orchard, and his neighbours also now do the like to their great advantage. Our country farmers run much upon planting orchards of these sweetings for fattening their swine, and assure me it makes the best pork: and I know the cyder made of them to be better than that of other fruit for taste, colour and keeping.

*The method
of making
sugar from the
juice of the
maple-tree
in N. England.
By P. Dudley
Esq; n. 364.
p. 27. Jan.
&c. 1720.*

XII. **M**APLE-sugar is made from the juice of the upland maple, or that which grows upon the high lands. They first box the tree, as we call it, i. e. dig a hole in it: this box is made within a foot of the ground, and shelving inwards so as to hold about a pint; and in order to direct the juice to it the tree is barked a little above. Then they tap the box, or pierce a small hole in the side of it, and so by a reed, pipe, or bit of cedar channelled, draw off the liquor into a vessel placed to receive it. The season is from the beginning of February to the end of April, and then a good large tree will yield twenty gallons of juice, which being boiled about 16 hours will be reduced to three pints, and give better than two pounds of sugar. When it is taken off the fire they keep almost continually stirring it, otherwise it would candy as hard as a rock; to prevent which some put in about the bigness of a walnut of beef suet. This sugar is not only as good for common use as the W. Indian, but our physicians prefer it to all other for medicinal virtue.

XIII. **N**onnulli negotiatores in Hollandia, Anglia, Hamburgi, Dantisci, &c. qui maxime in coëmendo & divendendo spiritu vini Gallici occupati sunt, certum aliquod experimentum probatorium crepant, idque pro magno artificio ac singulari arcano venditant, firmiter persuasi se ope hujus experimenti non solum spiritum vini Gallici a spiritu frumenti, sed etiam genuinum ab adulterato discernere, atque ita in coëmendo genuino spiritu vini Gallici nequaquam defraudari posse. Hinc etiam tanquam indubitatum & infallibile probamentum, imo magnum aliquod arcanum quod non omnes calleant, adhuc existimatur; adeo ut nemo hunc liquorem probatorium nec olfaciendum, neque gustandum mihi concedere unquam voluerit, tametsi fide interposita protestabar me illorum commercio nec nociturum, nec artem hanc cum aliquo communicaturum. Quid quod nec ego ipse nec illi prænoscere quibant, utrum ego nudo olfactu vel gustu conjectando illico affecuturus essem quidnam rei & qua ratione parandum esset? Liquor est subfusco-flavescens: mercatores complent primo scyphum vitreum spiritu vini Gallici probando, deque liquore isto in scyphum illum vel unicam vel duas tresve guttas, pro quantitate spiritus vini infusi, instillant. Quod si bonus fuerit & genuinus spiritus vini Gallici, statim in fundo vitri impleti existit admodum cæruleus color pulcherrimus, qui caule mundiore agitated & cum reliquo spiritu permixtus totum vitrum colore cyaneo tingit; sin autem spiritus frumenti sit ne quicquam cyanei coloris in vitro conspicitur, sed spiritus ille colorem suum primigenium retinet etiamsi de liquore dicto vel vigecuplo plures guttæ instillantur. Sicuti igitur hic modus probandi generatim putum frumenti spiritum a puro puto spiritu vini Gallici, ex opinione mercatorum, discernit: ita hi consequenter huic hypothefi fidentes de utriusque spiritus vini & frumenti adulterinæ commiscelæ gradibus diversis judicant. Norunt enim ex conspecto colore cæruleo, nisi hic obscure talis, sed subcæruleus modo, cæsius, glaucus, aut ex cyaneo viridescens appareat, dijudicare spiritum vini non solum adulteratum, sed etiam quoad gradus tot plusve minusve partibus spiritus frumenti mixtum esse. Fateor equidem hanc rationem probandi spiritus, ubi primum eam animadverti, admiratione quadam & delectatione me affecisse, ita ut eam omnino certam & falsi nesciam primo adpectu crediderim, quo etiam magis nunc talibus mercatoribus & oenopolis, rerum chymicarum ignaris, inscrutabilem sibi errorem condonare possum. Quum autem animo mecum subinde agitarem quod nullum adhuc, quantum sciam, demonstrativum experimentum prosteret, cujus ope peculiares puri spiritus vini Gallici & quidem rectificatissimi partes constitutivas a spiritu frumenti æque rectificatissimo distinctas ostendere vel saltem suspicari possimus, sed quod uterque spirituum ex iisdem partibus essentialibus constet, in quam communem qualitatem simpliciter necessaria fermentatione rediguntur, ideo argumentatus quoque mecum sum, quod si qua notabilis diversitas in dictis spiritibus eveniat, ea non a mixto

Of an experiment for proving French brandy. By Mr. C. Neuman. n. 391. p. 398. Nov. 1725.

intrinsicco tanquam mixto spiritus vini formante, vel a vini indole ex quo spiritus destillatus fuit, sed necessario ab additamento quodam heterogeneo ad constituendum spiritum vini, qua talem, nullo modo pertinente ortum ducat; sive sub fermentatione aut destillatione peregrinum quid addatur, sive tingendo, extrahendo, vel ipsa commiscela aliorum liquidorum aut solubilium contingat. Quare varia ad rem pertinentia experimenta institui, quibus etiam facile impetravi conjecturæ meæ confirmationem, quod scilicet in ista per dictum experimentum apparenter proveniente diversitate nulla, sit ratione spiritus ardentis vera & essentialis distinctio, sed quod productio coloris cærulei, ex quo differentia judicatur, heterogeneo cuidam & ad specialem constitutionem spiritus vini plane non requisiti additamento debeatur, atque ita totum experimentum, quacunque demum verisimilitudine sese commendans, falsum sit, fallax, & inutile, id quod jam ulterius comprobabo.

Ab amico igitur qui Gedani cum quondam gustaverat, edoctus quod styptico sapore se exhibeat, cum huc omnia mea experimenta dirigerem, tandem reperi quod arcanum illud tanto in pretio habitum aliud nihil sit quam mera solutio martis in acido vitriolico, sive ex marte cum spiritu vitrioli soluto & cum aqua diluto, sive ex vitriolo Anglico, sive ex vitriolo quodam venereo-martiali præcipitando parato, sive ex mineræ cujusdam martis, qualis Hassiaca est, extractione constet, quamvis color cæruleus omnium elegantissimus cum ultima, nempe cum sic dicto liquore terræ martis solaris appareat: quo saturatior solutio est eo minus pro experimento faciendo requiritur. Additamentum autem illud flavedinem primum spiritui vini Gallici concilians, hinc & sub experimento cæruleum colorem provocans, lignum quercinum est, sive segmenta aut ramenta ejus cum spiritu vini infundantur, sive in dolio quercino novo fervetur spiritus usque dum flavedinem ex ligno extraxerit; quo magis autem flavescit eo magis cæruleus quoque cum liquore martiali evadit, nisi croco vel alia quadam re flava tinctus fuerit. Quod autem totum negotium non nisi ligno quercino debeatur, experimento sequenti in contrarium facto, confirmo: assumo nempe spiritum frumenti eundem, qui cum liquore neque cæruleum colorem exhibet neque ullam aliam mutationem subit, atque ideo a mercatoribus pro puro frumenti spiritu judicatur, huic indo ramenta quercina & infusa relinquo donec spiritus frumenti flavedinem spiritus vini Gallici fere contraxerit, filtrato huic spiritui dum liquorem vitriolicum, sicuti spiritui vini Francici, instillo, eundem colorem cæruleum & æque elegantem acquirō, nulla ne levissima quidem diversitate, aut dissimilitudinem indicante phænomeno interveniente; quod abunde testatur omnem mutationem coloris ex ligno quercino originem ducere. Possumus quoque spiritum frumenti cum alio quodam analogia ad lignum quercinum accedente, cum gallis, v. g. infundere, sequente similiter experimento. Succedit quoque res quodammodo cum cortice granati & aliis vegetabilibus adstringentibus, omnium
tamen

tamen optime cum ligno quercino cui cortices granatorum longe sunt inferiores, violaceum potius quam cæruleum colorem, & cum agitur viroris aliquid trahentem, exhibentes. Notatu dignum est quod perparum liquoris ex ligno quercino extracti sufficiat ad qualitatem spiritui frumenti bene multo inducendam pro cæruleo colore cum dicto liquore exhibendo; siquidem cum gutta unica infusi ligni quercini dimidiam spiritus frumenti unciam pro experimento subeundo aptam reddidi. Liquorem sive solutionem ex puro vitriolo martiali, nullatenus venereo, constare & paratam esse debere exinde apparet 1. Quod experimentum cum Goslariensi, Ungarico, Dantiscano, omnibusque similiter mixtis vitriolis, quæ qualitercunque venerea vel cuprea sunt, pro copia cupri commixti plus minus male succedat, & colorem valde dilute cæruleum seu cæsum producat. 2. Quod cum puro vitriolo veneris plane non succedat, nec ullum colorem cæruleum provocet, sicuti id variis experimentis infra in ejus testimonium allatis tentando didici.

Dicendum adhuc restaret quibus de causis & quomodo color iste cæruleus oriatur; quia vero rem pro incipiente, vel diluto, atramento scriptorio habeo, cujus ingredientia, colorem suppeditantia, præcipua ex iisdem, nempe ex vitriolo martis & adstringente vegetabili constant, de quibus D. Lemery † scite & copiose differuit, hunc potius allegare volui illis qui talibus delectantur. Qui opticis aliisque philosophicis rationibus capiuntur D. Boyle, Newton, & alios legant qui de coloribus scripserunt. Inter Gallici vini & frumenti spiritum, purum nempe hunc & cum cura destillatum, non alia quam peculiaris odoris & saporis in Francici spiritu vini a vinaceis petiolis & acinis uvarum oriundi differentia indagari debeat; licet idem quoque odor & sapor variis modis spiritui frumenti conciliari, atque hic ita in Francicum adulterari queat, ut eam vel peritissimus pro genuino Francico aut ad minimum pro frumenti spiritu plane non habiturus sit; unde apparet quod non hoc tantum sed & alia experimenta spirituum ardentium probatoria nullius vel saltem insufficientis usus sint.

1. Octuplas paravi solutiones vitriolicas, pro qualibet drachmas duas vitrioli & unciam unam cum dimidia aquæ communis destillatæ recipiendo. Habui autem solutiones vitrioli 1. Goslariensis, 2. Gedanensis, 3. Hungarici, 4. De Cypro, 5. Anglici, 6. Martis cum oleo vitrioli parati, 7. Martis ex vitriolo venereo martiali per præcipitationem facti, & 8. Solutionem mineræ martis Hassiacæ, vel sic dictæ solaris, cujus itidem binas tantum drachmas ad dictam aquæ quantitatem assumpsi.

2. Triplices feci adstringentium vegetabilium extractions per infusionem, ad quamvis unciam vegetabilis libram unam medicam spiritus frumenti, qui à liquore probatorio antea instillato nihil plane cærulei ostenderat, accipiendo; fuerunt autem extractions 1. Ligni quercini, 2. Gallar. Turcic. 3. Granatorum corticum.

† Histoire de l'Académie des Sciences l'année 1707.

*An account of
the experi-
ments.*

3. Cum tribus hisce admodum saturatis extractionibus triplicem quoque Gallici vini spiritum adulterinum, colore saltem & flavedinem imitando, ex frumenti spiritu effinxi, & quibuscumvis octo spiritus frumenti uncias unam extractionis unciam singulatim commiscui.

4. Ordinarium sumpsi spiritum vini Gallicum flavescens, atque etiam ordinarium recens destillatum spiritum frumenti, & de utroque secundum ordinem modo dictum cum solutionibus vitriolicis experimenta cepi ac successive institui.

5. Infudi nempe quavis vice unciam dimidiam spiritus vini Francici in vitrum mundum infra acuminatum, & solutionis vitriolicæ unicam, vel si non sufficeret ad cæruleum colorem proferendum, duas, tres, usque ad quatuor guttas instillavi; vidique diligenter attendendo quod spiritus vini Gallici dictus 1. cum solutione vitrioli Gossariensis pallide cæruleum, 2. cum solutione vitrioli Gedanensis, & 3. vitrioli Hungarici itidem subcæruleum, 4. cum solutione vitrioli de Cypro autem nullum plane cæruleum, sed subviridescentem colorem induerit, 5. cum solutione vitrioli Anglici, atque 6. cum solutione vitrioli martis, cum oleo vitrioli parati, itidemque 7. cum solutione vitrioli martis per præcipitationem facti, valde elegantem, sed cum liquore martis solari sic dicto, seu solutione mineræ martis Hassiacæ, amoenissimum colorem cæruleum acquisiverit. Causam diversitatis hujus supra jam dedimus.

6. Cepi porro pro quovis experimento probatorio dimidiam itidem spiritus frumenti unciam, & cujusvis solutionis vitriolicæ unam, duas, tres, imo decem & plures guttas instillavi, sed à nullius neque etiam ipsius liquoris sæpius dicti commiscela, quamvis plus ad hunc, quam ad Gallici vini spiritum additum fuerit, ullam ne levissimam quidem livedinem cærulei coloris observare licuit.

7. Postmodum assumpsi dicti sub numero 3. & de eodem spiritu frumenti triplici modo imitando effecti spiritus vini Gallici unciam dimidiam pro quovis experimento, eandemque cum ordinario spiritu vini Francici factam, ac sub numero 5. commemoratam instillationem cujusvis solutionis vitriolicæ institui, & ecce conveniebant experimenta cum genuino & cum adulterato hoc spiritu vini Gallici facta, per omnia phænomena; nisi quod propter combinatas variorum vegetabilium extractiones aliqua hinc inde quamvis admodum levis differentia interveniret, uti ex sequentibus apparebit.

8. Spiritus frumenti cum extractione gallarum ab instillata solutione vitrioli 1. Gossariensis, itidemque 2. Gedanensis nigrescebat quodammodo, 3. cum solutione vitrioli Hungarici ab initio, sub instillatione, dabat quidem aliquid cærulei, sed inter commiscendum perdebat penitus, 4. cum solutione vitrioli de Cypro plane non tingebatur, 5. cum solutione vitrioli Anglici eleganter cærulescebat, & 6. cum solutione martis utroque modo parati, ab initio quidem cæruleo, sed commiscela vero & interagitatione cum caule pennæ, violaceo

laceo colore tingeatur; denique 7. cum solutione mineræ martis, & quidem una saltem ejus gutta, mixtus hic spiritus frumenti egregium acquisivit colorem cæruleum.

9. Spiritus frumenti extractione corticum granatorum, ceu dictum, imbutus, cum solutionibus vitriolicis juxta ordinem præcedentem confusus parum vel nihil cærulei provocavit, & circa priora quatuor puncta eodem fere modo se exhibuit atque supradictus frumenti spiritus gallarum extractione imprægnatus, in posterioribus quoque experimentis mox viridiusculi quid, mox atramenti æmulum ostendebat.

10. E contrario spiritus frumenti extractione ligni quercini in similitudinem quandam Gallici infucatus, cum solutionibus vitriolorum pure martialium, & præ cæteris cum liquore martis solari, omnium pulcherrimo colore cæruleo inficiebatur. Cum primis quatuor solutionibus vitriolicis vero eodem se modo habuit ac cæteri spiritus frumenti fucati, imo non secus ac ipse spiritus vini Gallici.

11. Tandem cum satis essem confirmatus rem cum ramentis ligni quercini optime succedere, experiri libuit quantum infusi vel extractionis ligni quercini, ad minimum pro aliquali saltem cæruleato colore producendo, requireretur. Varias ergo quantitates minuendo semper parciore, à dimidia drachma ad viginti, quindecim, & pauciores guttas descendendo, probavi, adeo ut unica gutta sufficeret totam semiunciam spiritus frumenti qualitate imprægnando, quæ ad colorem cæruleum, licet non adeo saturatum, unica saltem gutta liquoris mineræ martis accedente, producendum requiritur.

XIV. 1. Exp. 1. **T**HE æther of plants appears to be almost destitute of all gross air; for exhaust the air ever so accurately this æthereal liquor remains unmoved, nor does it emit any air-bubbles which immediately arise in other liquors, and according as their quantity of intrinsic air is greater so much the sooner are such liquors put into agitation, and they emit also more froth and make more vehement ebullitions in proportion to their viscosity. Hence this æther may be preserved best without any diminution under the receiver in vacuo; whereas when exposed to the open air it soon evaporates. (This experiment failed remarkably.)

An account of a spiritus vini æthereus, with several experiments tried therewith. By Dr. Frobenius. n. 413. p. 283. March &c. 1730.

Exp. 2. A little of it poured on the surface of the hand affects it with a sense of cold equal to that from the contact of snow, and blow upon it but once or twice with your mouth, immediately your hand becomes dry. Beware however of approaching a lighted candle with your hand thus wet, lest it take fire and burn you. (Succeeded.)

Exp. 3. It causes a stridor and hissing when poured upon warm water, as if a piece of hot iron were thrown into it. Take a lump of sugar, let it imbibe some of this æthereal liquor, and put it into a vessel full of hot water, the sugar will indeed sink to the bottom, but the æthereal liquor rushing violently forth excites a great ebullition. If

one

one spoonful of this æther be poured into a copper-pot full of boiling water without any sugar in it, and you approach immediately with a candle or a lighted paper, instantly there issues forth from the water very great lightning. The handle of a spoon as well as the tongs for holding and applying the lighted paper must be of a proper length, that the effusion of the ætherial liquor upon the hot or boiling water, and the application of the lighted candle or paper may be performed at the same time; otherwise the æther is immediately dissipated without any such effect. There is therefore need of an assistant or of both hands, and also of a room where fresh air may readily enter in proportion to the magnitude of the flash of lightning, which so rarifies the air as to endanger the stoppage of respiration. (Succeeded.)

Exp. 4. Hence it appears that this æther is both a very fluid water, but so volatile that it soon evaporates, and also the purest fire; insomuch that if kindled in a thousand times the quantity of cold water it burns inextinguishably. Wherefore if you take an earthen vessel of any magnitude, whose mouth or orifice may be one or two yards wide, but the inferior latitude of the vessel may contain 600 or 6000 gallons of water, the experiment will be the same; pour on the top but one ounce or a small vial full of this æther, and apply to it a lighted wax-candle, it takes fire immediately, burns placidly, and is so far from being extinguished by the most profuse super-effusion of common water that it much encreases the vehemence of the flame, and lasts till the subtil parts of the æther are consumed. This experiment should be made in a large and lofty room, not in danger of taking fire. (Not shewed.)

Exp. 5. The sense of touch does not manifest the least oiliness or fatness in this æthereal liquor, notwithstanding that it is the true, natural, and only dissolvent or menstruum of all fat, oil, rosin and gum whatsoever: by means whereof all sorts of fat, and every kind of fire or flame is extricated by a speedy, safe, and pleasant operation. On these accounts it is that this æthereal liquor will not unite with any kinds of salts whatsoever, but all sorts of oils, pitch, turpentine, opobalsams, camphire, wax, ambergrease, sperma ceti, mastic, musk, copal, and the like, it dissolves most readily, and with the greatest ease extracts their best essences.

Exp. 6. And indeed a wonderful harmony is observable betwixt gold and this æther, even greater than between gold and aqua regia; insomuch as from hence gold appears to approach nearer to the nature of oils than of earths, as shall be proved when we treat in their proper place of the three harmonious menstrua which we have discovered, viz: the corrosive one for the devoration or dissolution of earths, minerals and metals; the aqueous one for the dissolution of all kinds of salts; and lastly, the æthereal liquor or oleous menstruum. If a piece of gold be dissolved in the best aq. regia, and upon the solution cold be poured half an ounce or what quantity you please of the æthereal

liquor, shake the glass carefully, and all the gold will pass into the æthereal liquor, and the aqua regia robbed of all its gold will presently deposit at the bottom of the vessel a white powder, which turning of a green colour contains the portion of copper where-with the gold was adulterated. The æther will swim like oil on the surface of the corrosive waters. The experiment deserves the utmost attention; for here the heaviest of all bodies, gold, is attracted by this very light æther. (Succeeded.)

Exp. 7. Æther then is certainly the most noble, efficacious and useful instrument in all chymistry and pharmacy, Ubi enim ignis potentialis, ibi actuali non opus est, inasmuch as essences and essential oils are extracted by it immediately, without so much as the mediation of fire, from woods, barks, roots, herbs, flowers, berries, seeds, &c. from animals, and their parts too. Thus from castor by a certain manufaction may be prepared an oil sweeter than that of cinnamon, and also the true oil of saffron, of wonderful efficacy; and all by this particular encheiresis, without the help of fire or distillation. For an example of our method, take mint, sage, or orange-peels, cinnamon, &c. or all these together, cut and bottle them, pour upon them a spoonful or two of the æthereal liquor, and after it has stood an hour in a cool place fill up the bottle with cold water, and you shall see the essential oil swimming upon the water, and easily separable by the funnel or instrumentum tritorium. Of this essential oil one drop only upon a lump of sugar manifests to the taste, &c. the medical virtues of the plant, exquisitely drawn out, comprehended in this essence, deservedly named Cos, as containing the colour, odour and sapor or taste of the plant or plants. In like manner the essential oils of exotics are easily prepared. (Succeeded; but it is not a true essential oil, but an excessive strong tincture, which you may call the essence.)

Exp. 8. Of the like use it is in the animal kingdom, where it produces an essential oil of phosphorus, as likewise in the mineral kingdom, though not so immediately, because the resolution of earths must precede. Moreover, it is easily proved that the same liquor extracts the purest gold, or every part of the golden system from any or all the baser minerals, and that the gold thus extricated is by this one operation better and sooner purified than by fusion of minerals with antimony.

Exp. 9. This our water is neither corrosive nor joined with apparent corrosives: wherefore fill as many bottles with æthereal water as there are sorts of salts, and into the first drop by drop distil oil of vitriol; put into the second spirit of sea-salt, into the third spirit of nitre, or of alum, or of sal armoniac prepared with water, or the lixivium of tartar, or rectified wine-vinegar, all the salts immediately sink to the bottom: besides, it is the lightest of all liquors; for fill any vessel with twenty ounces of oil of vitriol, the same emptied will contain but seven ounces of æther. It is the very ens or being most
pure

*Of the same.
By Mr. God-
frey. ibid.
p. 288.*

pure of flame; wherefore neither foot nor ashes are ever found upon its deflagration. (Succeeded.)

XIV. 2. **T**HAT this liquor æthereus was formerly very much esteemed and enquired into clearly appears by an experiment I made formerly for my worthy master, Mr. Boyle, by the means of a metallic solution; namely, by the solution of crude mercury united with the phlogiston vini or other vegetables, and this æther which swam on top of the solution I separated per tritorium. Sir Isaac Newton was very well acquainted with it too; but his death prevented his bringing it to such perfection as to make it readily in quantities. But when Dr. Frobenius by experiments on it in my laboratory did produce it in greater quantities, he wanted to see how far Sir Isaac Newton had gone on with it in his book. There we saw that great man's application in fol. 330, and that he had done it cum ol. vitr. & sp. vin.

This of Sir Isaac Newton is the sp. vini æthereus, only there is a difference in the process. The liquor æthereus is made with equal parts in measure not weight. The upper yellow liquor is separated from the inardent sulphureous per tritorium. The inferior liquor is thrown away; and the superior yellow is put into a retort to be distilled with the most gentle heat; and the extraction of the æthereal liquid is continued until the superior hemisphere feels cold, and the retort being clapped in the hand, there is found in the receiver a vino-sulphureous gas very æthereal. Let the sulphur be precipitated by adding an alkali, and gently throwing it in till all ebullition ceases, and the liquor will not farther strike itself against the hand, but will strangely attract it. Then the alkali will go to the bottom of itself, or precipitate itself in the common water.

*The prepara-
tion of the
Prussian blue.
By ———
to Dr. Wood-
ward. n. 381.
p. 15. Jan.
Æt. 1724.*

XV. 1. **R** Artari crudi & nitri crudi siccati ad ꝑiii. pulverisentur minutissime & commisceantur, deinde admoto igneo carbone detonentur, & habebis salis tartari extemporanei ꝑiii. Dum adhuc calidum est hoc sal. pulverisetur subtilissime, & addantur sanguinis bovini probe exsiccati & subtiliss. pulv. ꝑiii. Hæc bene mixta indantur crucibulo, ita ut tertia pars vacua sit; imposito dein operculo igni committatur & circumdetur crucibulum carbonibus ut sensim ardescat & materia sine præpropere accensione flammam concipiat & ignescat. In hoc ignis gradu teneatur materia donec flamma & accensio remittat; augeatur demum ignis ut valde candeat materia & parum flammæ e crucibulo amplius emineat. Remove demum ab igne crucibulum & materiam mortario ingestam leviter contere, & ad manus habeto aquæ ferventissimæ pluvialis libras 4 ponderis civilis, cui materiam adhuc ferventem immitte & per semihoræ spatium coque; decoctum per linteum coletur, & materia remanens nigra aquæ portioni denuo affusa igni iterum apponatur, coquatur, & percoletur; id quod eousque continuandum donec salsedo & acrimonia omnis e materia sit elixiviata & aqua redeat insipida. Humores omnes in linteo & materia residuos fortiter exprime, & ubi singula in unum collegeris,

legeris, igni iterum committe, & ad remanentiam 4 librarum evapora, & ulteriori usui ferva, sub no. 1.

R. Porro vitrioli Anglici ad albedinem leviter calcinati $\bar{z}$ i. solvatur in aquæ pluvial. $\bar{z}$ vi. filtretur per chartam & signetur no. 2.

R. Denique aluminis crudi $\bar{z}$ viii. solvatur in libris 4. aquæ ferventissimæ ad omnimodam aluminis consumptionem; hoc rite peracto adijunge solutionem vitrioli sub no. 2. asservatam, quæ ex igne fervens ingeratur ollæ satis magnæ & amplæ, & cum lixivio no. 1. seorsim bene servefacto combinetur. Fiet ex continenti magna ebullitio, & apparebit color viridis montani seu chrysocollæ; effundatur alternis vicibus, durante ebullitione, ex uno vase in aliud, qua cessante quieti committe. Tum linteo insinuetur, ut aquositas transeat, color vero in linteo remaneat; si igitur nihil humiditatis amplius destillet, cum spatula lignea e linteo in ollam novam minorem remove; superfunde postea spiritus salis comm. $\bar{z}$ ii. vel $\bar{z}$ iii. & statim apparebit color cæruleus pulcherrimus: quæ probe mixta per noctem quiescant, quo facto aquæ pluvialis magna quantitas addatur, in gyrum moveatur spatula, & posteaquam refedit materia aqua decanetur, recens aqua superfundatur, & eousque labor reiteretur donec omnis acrimonia sit desumpta & aqua insipida defluat; hoc pacto præcipitatum tuum summe cæruleum linteo expansoingere ut aqua destillet sensimque color calore leni exsiccetur usui. Calcinationo magni momenti est in hoc opere, nam color cyaneus & cæruleus obscurus ortum suum trahit a calcinatione levi, mediocri, & forti sanguinis arefacti cum sale tartari, & inde diversitas coloris. Lixivia ferventissima uno eodemque festinatissimo actu sunt confundenda.

XV. 2. **D**R. Woodward having communicated to the society a process for making the Prussian blue, I was willing to go thro' it exactly according to the proportions there prescribed; and observed that by a calcination of $\bar{z}$ 4 of blood dried with $\bar{z}$ 4 of salt tartari, in two hours time that part of the operation was over, and a black spongy substance remained in the crucible weighing $\bar{z}$ 4. a dissolution of which being made in boiling water and afterwards filtered, the remainder dried weighed 9 drachms, avoirdup. the former having been weighed by the same kind of weight. The loss in the dissolution and filtration of the vitriol and alum is not worth taking notice of, they having both been very clean before they were dissolved. The mixtures being made as prescribed, with the addition of the spiritus salis, the product was a very fine blue, which when well edulcorated by frequent washings and after that thoroughly dried weighed $\bar{z}$ 1. or a little more, and entirely answered the character which the author gives of it.

Among the several experiments that were made with these liquors, I mean the lixivium with blood, the solution of vitriol, the solution of alum, and the spirit of salt, tho' they always produced a blue, yet that blue differed in degrees of colour according to the varied proportions of the vitriol and alum, and the colours produced from these several proportions were each of them improved by the addition of

*Observations
and experi-
ments upon the
foregoing pre-
paration. By
Mr. J. Brown.
ibid. p. 17.*

the sp. falis. I shall mention only two of the several I tried, in one of which the alum was entirely left out, and a pale blue produced; in the other, the proportions of vitriol and alum were equal, and a very deep blue was produced. These differences in colour, arising from the several proportions of the vitriol and alum, are only mentioned to confirm the truth of the Author's prescript, as being the most exact and best proportioned to produce the finest colour of any I have tried. The only misfortune he takes notice of as attending his prescript is what may happen in the calcination. It would be curious to know what gave the first hint for the production of so fine a colour from a combination of such materials; especially when we come to consider that the blood has the greatest and principal share in this surprizing change. I doubt not but blood of any kind, or flesh of any kind, would produce the same effects, but have reason to believe the latter would not produce so beautiful a colour as the former. I purposely dried some beef freed from its skin and salt, and pursued the same course as with the blood; but there was a sensible difference to be observed during the calcination, and a very manifest one in the beauty of the two colours. To prove the share which the blood has in this change, the following experiments may be convincing. The solution of alum mixed with that of the vitriol produceth no alteration of colour: if to these you add the spiritus falis the appearance is the same; but if to the whole you put the lixivium with blood there precipitates a blue. If instead of the lixivium with blood you substitute a lixivium made with the same salt of tartar only, which then becomes an ol. tartari; and after the mixture of the solution of alum with that of the vitriol you pour on this ol. tartari, there follows indeed a precipitation, but of no colour; and if you add the spirit of salt, it so strongly attracts what is precipitated as to render the muddy mixture perfectly clear. The very same effect will follow if any volatile alcalious spirit is made use of as a precipitant, or any volatile salts dissolved in water; nor can the blood itself be supposed to communicate this change from any such properties, the heat of fire it undergoes in the calcination being sufficient to throw them off. In the calcination of the dried blood and salt of tartar it was observed that there was a loss of just half. It is difficult to determine exactly what quantity of either was lost by this calcination, but it will easily be granted that there was lost a far larger quantity of the blood than of the salt of tartar; and that is obvious from an experiment by which, when the salt of tartar was calcined by itself with the same degree of heat, it lost less than an $\frac{1}{8}$ part, whereas when the dried blood was calcined by itself it lost more than $\frac{4}{8}$. The blood in calcination with the salt of tartar communicates its tinging quality to the salt, or that quality is extracted from it by the salt and passes with it in its dissolution in the boiling water. To prove this, some dried blood was calcined by itself and a strong decoction made of it in water and afterwards filtered: this mixed with the former solutions produced little or no alteration;

but on the addition of the spiritus salis changed to an amber colour without any precipitation. When this liquor was mixed with the ol. tartari and poured to the former solutions, it caused a precipitation but no colour, and the spiritus salis, as in the other experiment, made the liquor clear again, but left this also of an amber colour. The change of colour is not effected in any of the materials, except in that of the solution of vitriol; so that the alum seems only to be of use in fixing the colour, as is often used by the dyers for that purpose, and the spiritus salis gives it a deeper dye. For if the lixivium with blood be poured to the solution of alum alone there will fall a sediment a little on the purple, to which if you add the spiritus salis it changes the colour and the sediment is of a brown. So, much the same changes will be produced if you pour the spiritus salis to the lixivium, but not the least appearance of a blue, whereas when the lixivium is poured to the solution of vitriol there immediately follows the blue, which is still heightened by the addition of the spiritus salis. It will not be improper to take notice, that as the author orders all the liquors, except the spiritus salis, to be boiling hot when mixed, so it is certain the colour is thereby more immediately produced and looks more beautiful; but most of the experiments here mentioned were made with the liquors cold, and the colours came to their beauty with a little washing. In one of the experiments with the liquors cold, after the lixivium with blood had precipitated the blue in the mixture of alum and vitriol, by pouring in a little more of the lixivium, the blue all disappeared, and an ugly muddy colour was left; but the addition of the spiritus salis soon discharged that and the blue returned. In calcining the beef and salt of tartar I found the matter left in the crucible to weigh just half of the whole mixture, as in that with the blood; but after boiling it in water, the residuum in the filtre when dried was very near a third less in proportion than the other. From whence may be reasonably inferred, that the salt of tartar holds a larger share of the beef in the one operation than of the blood in the other.

Having in the former part of this account of the Prussian blue proved, by the experiments there mentioned, that the solution of vitriol was the only subject among those ingredients in which the lixivium of blood produced this change of colour; and having since considered that the vitriol made use of in this preparation is no more than iron dissolved by a liquor running from the pyrites when exposed to the weather, which is afterwards boiled up and shot into crystals; it seemed to follow as a natural consequence that this metal is the subject on which the lixivium of blood produces the change; and this thought gave occasion to the following experiments on metallic bodies, in order to observe if the same change of colour could be produced in any of them. To a solution of silver in aquafortis was poured the lixivium of blood, which occasioned a coagulum of a pure flesh colour. The lixivium made with flesh produced a whitish coagulum, and the ol. tartari (which was continued to be used by way of comparison with the other lixivium) a much whiter. By the addition of the spiritus salis to each of these the bloom of the
flesh

flesh colour was taken off in the first, but suffered no other change. In the second the coagulum was a little tinged with blue; and in the third the white was manifestly improved. The bluish tinge in the second of these experiments cannot entirely be assigned as the effect of the lixivium with flesh; because silver thus dissolved, whether precipitated with salt water or ol. tartari, will after it has stood some time contract a bluish tinge, caused by an alloy of copper from which it is not entirely freed. The same liquors were made use of to precipitate the mercury in the mercurius sublimatus corr. dissolved in water; the consequence of which was that the lixivium with blood produced a pure yellow; the lixivium with flesh an orange colour; and the ol. tartari a dingy red. The addition of the spiritus salis to these made some very odd alterations; for the first changed its yellow colour for an orange; the second its orange for a blue; and the third became quite clear again without any colour. The blue colour in the mixture of the lixivium with flesh and solution of sublimate may be accounted for from the vitriol in the composition of the sublimate; but it will not be so easy to give a reason why the same colour should not have been produced from the lixivium with blood and the same solution. Copper dissolved in aquafortis tinges the water of a green colour; and if to this you pour the two lixivia of blood and flesh the coagula are much alike, viz. a white tinged with green; but when you add the spiritus salis they both change and become of a colour not unlike the copper itself before it is dissolved in the aquafortis. If the ol. tartari be poured to a solution of the copper the coagulum is a pale green, which coagulum the spiritus salis dissolves and leaves the liquor clear, but green as before precipitation. Tin-glass (an imperfect metal) dissolved in aquafortis and mixed with the lixivium of blood made a milky coagulum, and by the addition of the spiritus salis, after some time standing, its upper surface changed to a light blue. The lixivium of flesh and the ol. tartari produced both white coagula, which the spiritus salis scarcely alters. Lead dissolved in spirit of vinegar produceth much the same white coagulum, when mixed either with the lixivium of blood, flesh, or the ol. tartari, nor doth the spiritus salis make any alteration.

By all these experiments it is pretty evident, that none of these metallic bodies were affected by the lixivium of blood so as to produce this fine blue. The two metals untried are gold and tin, the latter of which dissolved in spirit of vinegar has so near a resemblance to lead dissolved in the same menstruum, that in all probability the experiments would answer much alike in both. What may be expected from gold I am not yet so well assured of as I am from iron, which when dissolved in spiritus vitrioli will answer all the experiments that have been tried with the solutions of vitriol and produce as fine a colour; nor can this be owing to any property in the dissolvent itself, which, tho' drawn from the same kind of vitriol all along made use of in these experiments, yet is so altered by the violent fire in the production of it as not to answer in any trials to the vitriol itself. May we not therefore hence conclude that iron is the metal which is the subject of this beautiful colour produced by means of the lixivium with blood?

The End of the Third Part.



THE
Philosophical TRANSACTIONS
ABRIDGED.

PART IV.

Containing the

Philological & Miscellaneous PAPERS.

CHAP. I.

Chronology, History, Antiquities.

I. NOV. 11, 1725. A small tract in print was delivered to me as a present from Mr. W. Cavelier, jun. bookseller at Paris, a person unknown to me, entituled, "Abregé de Chronologie de M. le Chevalier Newton, fait par lui même, & traduit sur le manuscrit Anglois." The bookseller in an advertisement prefixed endeavours to justify his printing it without my leave, by saying that he had writ three letters to me to desire it, and in the third had told me that he would take my silence for a consent; that he had also charged one of his friends in London to speak to me and procure an express answer; that having long expected my answer, he thought he might take my silence for a sort of consent, and so procured a privilege and printed it; after which he received my answer from his friend, which was as follows.

Remarks upon the observations made on Sir I. Newton's chronological index. By Sir I. Newton. n. 389. p. 315. July &c. 1725.

"I remember that I wrote a chronological index for a particular friend, on condition that it should not be communicated. As I have not seen the M.S. which you have under my name, I know not whether it be the same. That which I wrote was not at all

“ done with design to publish it. I intend not to meddle with that
 “ which hath been given you under my name, nor to give any con-
 “ sent to the publishing of it,

ISAAC NEWTON,

The privilege was granted May 21, and register'd May 25, O.S. and the chronological index, or abridgment as he calls it, was printed before the arrival of my letter (which was dated May 27 O.S.) and kept ever since to be published at a convenient time. The bookseller knew that I had not seen the translation of the abridgment, and without seeing it could not in reason give my consent to the impression. He knew that the translator was unknown to me, and was against me; and therefore he knew that it was not fit that I should give my consent, nor be asked to do it. He knew that the translator had written a confutation of the paper translated, and that this confutation under the title of observations, was to be printed at the end of it; and he told me nothing of all this, nor so much as the name of the observator, and yet asked my consent to the publishing; as if any man could be so foolish as to consent to the publishing of an unseen translation of his papers made by an unknown person, with a confutation annexed and unanswered at their first appearance in public. After the recital of my letter he adds, that the author of the translation and of the observations upon it pretends to have an entire certainty that this index or abridgment of chronology is the same with the writing owned by me in my letter, and is persuaded that the M.S. communicated to him was copied from that of this friend, that is, from that of the particular friend abovementioned in my letter. And therefore the M.S. communicated to him is that of Abbè Conti a noble Venetian now at Paris. He being about seven years ago in England gave me notice that the friend abovementioned desired to speak with me. This friend desired a copy of what I had written about chronology. I replied that it was imperfect and confused, but in a few days I could draw up an abstract thereof, if it might be kept secret. Some time after I had done this and presented it, this friend desired that Signor Conti might have a copy of it. He was the only person who had a copy, and he knew that it was a secret, and that it was at the desire of this friend, and by my leave, that he had a copy, and he kept it secret while he staid in England, and yet, without either this friend's leave or mine, he dispersed copies of it in France, and got an antiquary to translate it into French and confute it; the antiquary hath got a printer to print the translation and the confutation; and the printer hath endeavoured to get my leave to print the translation, without sending me a copy thereof to be perus'd, or telling me the name of the translator, or letting me know that his design was to print it with a confutation unanswered and unknown to me.

The translator near the end of his observations (page 90) saith, I believe that I have said enough concerning the epocha of the Argonauts
 and

and the length of generations to make people cautious about the rest. For these are the two foundations of all this new system of chronology. What he says concerning the epocha of the Argonauts is founded on the supposition that I place the equinox, in the time of the Argonautic expedition, fifteen degrees from the first star of Aries, p. 75, 79. I place it in the middle of the constellation, and the middle is not fifteen degrees from the first star of Aries. The observer grants that the constellations were formed by Chiron (p. 70, 71, 79.) and that the solstices and equinoxes were then in the middle of the constellations (p. 65, 69, 75.) and that Eudoxus, in his *Enoptron* or *Speculum* cited by Hipparchus, followed this opinion, p. 62, 63, 65, 69, 79. And † Hipparchus names the stars through which the colures passed in this old sphere, according to Eudoxus, and saith expressly that Eudoxus drew one of these colures through the middle of Cancer and the middle of Capricorn, and the other through the middle of Chelæ and the back of Aries. And the colurus passing through the back of Aries passes through the middle of Aries, and is but eight degrees from the first star of Aries. I follow Eudoxus, and by doing so place the equinoxial colure about 7 gr. 36' from the first star of Aries. But the observer represents that I place it fifteen degrees from the first star of Aries, and thence deduces that I should have made the Argonautic expedition 532 years earlier than I do. Let him rectify his mistake, and the Argonautic expedition will be where I place it.

As for the length of generations, the observer saith that I reckon them one with another at eighteen or twenty years a piece (p. 52, 55.) which is another mistake. I agree with the ancients in reckoning three generations at about an hundred years. But the reigns of kings I do not equal to generations, as the ancient Greeks and Egyptians did. I reckon them only at about eighteen or twenty years a piece one with another, when ten or twelve kings, or more, are taken in continual succession. So the first twenty four kings of France (Pharamond, &c.) reigned 458 years, which is one with another nineteen years a piece. The next twenty four kings of France (Ludovicus Balbus, &c.) reigned 451 years, which is one with another eighteen years and $\frac{1}{4}$ a piece. The next fifteen kings (Philippus Valesius, &c.) reigned 315 years, which is one with another twenty one years a piece. And all the sixty three kings of France reigned 1224 years, which is nineteen years and a half a piece. And, if the long reign of Lewis XIV. be added, the sixty four kings of France will reign but twenty years a piece. Those that examine the matter will find it so in other kingdoms. I shorten the duration of the ancient kingdoms of Greece in the same proportion that I shorten the reigns of their kings, and thereby place the Argonautic expedition about forty four

† See Hipparchus published by Petavius, Vol. 3. p. 116, 117, 119, 120.

years, and the taking of Troy about seventy six years after the death of Solomon, and find Sesostris contemporary to Sefac. So then the observator hath mistaken my meaning in the two main arguments on which the whole is founded, and hath undertaken to translate and to confute a paper which he did not understand, and hath been zealous to print it without my consent; though he thought it good for nothing but to get himself a little credit, by translating it to be confuted and confuting his own translation.

The observator saith that I suppose the Egyptians began, about nine hundred years before Christ, to form their religion and deify men for their inventing of arts, notwithstanding it appears by the scriptures that their idolatry and arts were as old as the days of Moses and Jacob, p. 82, 83. But he is again mistaken. I deny not that the kingdom of the lower Egypt called Mizraim, had a religion of their own till they were invaded and subdued by the shepherds who were of another religion: but I say that when the Thebans expelled the shepherds they set up the worship of their own kings and princes. I say also that arts were brought into Europe principally by the Phœnicians and Curetes, in the time of Cadmus and David, about 1041 years before Christ; and do not deny that they were in Phœnicia, Egypt, and Idumea before they came into Europe.

The observator saith also that 884 years before Christ I place the beginning of the canicular cycle of the Egyptians upon the vernal equinox, although that cycle never begins in spring, p. 84, 85. But he is again mistaken. I meddle not with that cycle, but speak of the Egyptian year of 365 days.

The observator represents that I have a great work to come out: but I never told him so. When I lived at Cambridge I used sometimes to refresh myself with history and chronology, when I was weary with other studies: but I never told him that I was preparing a work of this kind for the press.

Abbè Conti came into England in spring 1715, and while he staid in England he pretended to be my friend, but assisted Mr. Leibnitz in engaging me in new disputes, and hath since behaved in the same manner in France. The part he acted here may be understood by the character given of him in the *Acta eruditorum* for the year 1721, p. 90. where the editor, excusing himself from repeating some disputes which had been published in those *Acta*, subjoins: "*Suffecerit itaque annotasse abbatem quendam Italum de Conti nobilem Venerum (de quo admiratione digna sibi perscripta esse ab Hermanno fatetur Leibnitius) cum ex Gallia in Angliam trajecisset, mediatoris vices in se suscipere voluisse, atque literas Newtoni ad Leibnitium deferri curasse, Leibnitianas cum Newtono communicasse.*" And how Mr. Leibnitz by this mediation endeavoured to engage me, against my will, in new disputes about occult qualities, universal gravity, the sensorium of God, space, time, vacuum, atoms, the perfection

section of the world, supramundane intelligence, and mathematical problems, is mentioned in the preface to the second edition of the *Commercium Epistolicum*. And what he hath been doing in Italy may be understood by the disputes raised there by one of his friends, who denies many of my optical experiments though they have been all tried in France with success. But I hope these things and the perpetual motion will be the last efforts of this kind.

II. 1. **T**Here was lately put into my hands a book published last year at Paris by P. Souciet a Jesuit, against Sir I. Newton's chronology, without waiting till the book be published, and without knowing the contents thereof, otherwise than by a short extract made at the desire of a very great person and without intention that it should be publickly seen. However, a copy thereof having been (as I suppose) surreptitiously obtained and carried over into France, was first translated into French, and then printed at Paris with a pretended refutation by the same P. Souciet. Sir Isaac having answered, as he thought, his objections †, has thereby given him a handle to publish five other dissertations against his system; the first and last of which, being chiefly astronomical, seem properly to fall under my examination (since the great author is no more) both as his majesty's astronomer, and on account of the long friendship that subsisted between the deceased and my self.

*Remarks on
P. Souciet's
dissertations
against Sir I.
Newton's
chronology. By
Dr. Halley. n.
397. p. 205.
Jan. &c.
1727.*

† Vid. §. 1.

And first, P. Souciet readily allows what seems to be the most exceptionable part of the whole system, viz. that Chiron the centaur fixt the colures, in the ancient sphere of fixt stars, in the same places as Hipparchus tells us they had been supposed by Eudoxus many centuries of years after Chiron. His words are these, ἐν δὲ τῷ ἐτέρῳ κολῦρῳ φησὶ κεῖσθαι τῇ κήτυς τὴν κεφαλὴν, ἢ τῇ κελὶ τὰ νῶτα κατὰ πλάτῃ. This undoubtedly was the position of the colure of the vernal equinox many ages before Eudoxus; but whether so old as Chiron and the Argonautic expedition I shall not undertake at this time to enquire: I only observe that P. Souciet in his *Fastes du Monde*, or abridgment of his chronology, prefixt to these dissertations, makes the Argonautic expedition 1467 years before our *Æra* of the birth of Christ, and the taking of Troy 1388 years before it; which date is 120 years sooner than the Parian chronicle, read and published by Selden in his *Marmora Arundeliana*, makes it; and above five hundred years earlier than the time assigned by Sir Isaac Newton. Now both of them making use of the same premisses, it may seem strange that their conclusions should be so widely distant: and indeed upon a prepossession that the Argonautic expedition and the siege of Troy could not have been less than a thousand years before Christ, I must own I was at first somewhat prejudiced in favour of P. Souciet, taking his calculations for granted and not having seen Sir Isaac's work. But observing that he quotes Sir Isaac as saying, that in consequence of what Hipparchus has recorded from Eudoxus the equinoctial colure

in the old sphere was about $7^{\circ} 36'$ from the first star of Aries, I was resolved to examine the matter with due attention; especially since the good father seems to triumph over his adversary, and to treat a man of his figure in the commonwealth of learning in a very ludicrous manner, notwithstanding the several fine things he says of him to palliate it. I find the dispute to be chiefly over what part of the back of Aries the colure past: the words of Hipparchus, as from Eudoxus, are simply that it past over the back, without saying over what star or over what part of the back it past. And the same Hipparchus shews that if it past over the star in the middle of the back it greatly differed from the situation thereof in his time; and conceiving thence that the æquinoctial points might have a regressive motion, he was the first that attempted to define that motion; but having no observations older than those of Timocharis, made within less than two hundred years of his own time and very coarse withal, he was not able to determine the quantity thereof, but guest it to be about a degree in a hundred years; which length of time and the more curious observation of the moderns has now proved to be $1^{\circ} 24'$, or rather $50''$ per annum. In a word, Sir Isaac takes the colure to have past over the middle of the constellation of Aries and very near the star in the middle of the back (γ Bayero): and P. Souciet will have it that it past over the middle of the sign or Dodecatemorion of Aries, reckoning the sign to begin with the first star of the constellation; and by consequence his colure must pass about midway between the rump and first of the tail of Aries (ϵ and δ Bayero;) which could never be said to be over the back. But whilst Sir Isaac makes the colure but $7^{\circ} 36'$ from the first star of Aries, which P. Souciet makes 15 degrees from it, the difference $7^{\circ} 24'$, at $50''$ per annum, makes 533 years difference. Let us now examine when the stars in question did actually pass under the colure of the vernal æquinox, assuming their places as they are in Mr. Flamsteed's British catalogue fitted to the beginning of the year 1690. He places the first star of Aries in $28^{\circ} 51'$ of Aries with $7^{\circ} 9'$ north latitude. And supposing the obliquity of the ecliptic $23^{\circ} 29'$, it will be as radius to the tangent of $23^{\circ} 29'$:: so the tangent of $7^{\circ} 9'$ to the sine of $3^{\circ} 7' \frac{1}{2}$, the difference of longitude between the star and the point in the ecliptic which past under the colure at the same time with the star; so that this point was, anno 1690 ineunte, in γ $25^{\circ} 43' 30''$: and therefore allowing $50''$ per annum, the star was under the colure 1852 years before the epocha of the British catalogue, that is, 162 years before our æra of the nativity of Christ; in which very year Hipparchus began to observe the equinoxes recorded by Ptolemy lib. III. cap. 2. If therefore with Sir Isaac we add $7^{\circ} 36'$ to the long. of the first star of Aries, as it was in 1690, we shall have $36^{\circ} 27'$, which the colure moves in 2624 years: and deducting 1690 therefrom, we shall have 934 years before Christ for the Argonautic expedition. And if to $7^{\circ} 36'$ we add $3^{\circ} 7' \frac{1}{2}$ we shall

shall have $10^{\circ} 43' \frac{1}{2}$, that is, 772 years before the first star of Aries past the colure. Next let us inquire when the star in the middle of the back of Aries (γ Bayero) past the colure. Its longitude anno 1690 ineunte, was $9^{\circ} 48' 35''$ of Taurus, with north lat. $6^{\circ} 8'$; but by the foregoing analogy, the point in the ecliptic over which the colure past at the same time with it was $2^{\circ} 40' \frac{1}{2}$ before it, that is, in δ $7^{\circ} 8'$. Now $37^{\circ} 8'$ give 2674 years nearly, or 984 years before Christ when that star was under the æquinoctial colure, being but half a century earlier than Sir Isaac places the Argonautic expedition; and shews that he took the middle of Aries over which the colure is supposed to have past to be the middle of the constellation, and not of the Dodecatemorion; and in so doing no doubt had reason to place this colure $7^{\circ} 36'$ in consequence of the first star of Aries, instead of $8^{\circ} 17'$, as it was when the star in the middle of the back of Aries was under the colure. But if with P. Souciet you make the colure to intersect the ecliptic 15 degrees from the first star of Aries, or $43^{\circ} 51'$ from the æquinoctial point, as it was anno 1690, we shall have the time nearly 1470 years before Christ; but then the colure will be very far from the middle of the back of Aries, and leave only his tail to the eastward as it leaves the head of the whale to the westward, so as by no means to agree with the description we have of it from Hipparchus; which it were to be wisht had been more definitive, and as well circumstanced as what Hipparchus has left us of the position of the colures in his own time, which upon examination I find to be very consistent and the observations made with sufficient care.

Thus I hope I have shewn P. Souciet that there was no affectation of mystery in Sir Isaac's placing the colure $7^{\circ} 36'$ from the first star of Aries, nor any occasion to drole as he does p. 131, 132. on that account; as also that he ought to have deducted $3^{\circ} 7' \frac{1}{2}$ out of the 15 degrees he assumes for the distance of his colure from the first star of Aries, which will bring him 225 years nearer Sir Isaac's time. He is likewise entreated in the next edition of his Dissertations to be a little more careful of his numbers than he has been p. 134, 135, and to inform himself in the Spherics so as to give us the right ascensions of the stars truly from their given longitudes and latitudes.

Lastly, I would inform him that the star in the Centaur which Hipparchus describes, as being in his time very near the autumnal colure, was not ψ of Bayer but certainly ϕ ; and that, anno ineunte 1690, its longitude was Scorpio $8^{\circ} 43' 40''$, with south latitude $27^{\circ} 59'$. But the colure passing through that star, by the proportion given above, cuts the ecliptic $13^{\circ} 20' 50''$ in antecedence of the star, that is, in Libra $25^{\circ} 22' 50''$. But $25^{\circ} 22' 50''$ give 1827 years: wherefore this star was in the colure 137 years before Christ, when Hipparchus flourished and might very well observe it.

Continued by
the same to
Dr. Jurin. n.
399. p. 296.
July &c.
1727.

† Vid. § II. 1.

II. 2. **W**hen I gave you my remarks † on P. Souciet's dissertations against Sir Isaac Newton's chronology, I was obliged to take what he was pleased to give us out of Hipparchus's comment on Aratus, not having that author by me. Since that time having got the Florence edition of Hipparchus, anno 1567, I find an argument very much ad hominem, which the R. P. must confess will bring the Argonautic expedition full as low as Sir Isaac places it.

P. Souciet in his fifth dissertation, p. 119, 120, finds out a star of the first magnitude close adjoining to that we now call the first star of Aries, as it is in the catalogue of Ptolemy, where it is said to be in the horn of Aries and not in the ear. This star the R. P. supposes long since to have disappeared; but that being of old very considerable, it was from this first star of Aries the zodiack began, though for argument-sake he is contented to let it begin, as Sir Isaac does with the aforesaid star in the ear or horn; which Hipparchus, in p. last and 54th tells us in his time followed the equinoctial colure the 20th part of an hour: and supposing the star that has disappeared to have been at that time precisely on the colure, it must differ but forty five minutes of right ascension therefrom: how he comes to make the difference of longitude 40 minutes no way appears, and is, gratis dictum.

In p. 49 of the Florence edition Hipparchus treating of the rising and setting of the constellations, tells us that that of Aries began to rise with $18^{\circ}\frac{1}{2}$ of Pisces in the ecliptic, and was wholly risen with the 24th deg. of Aries, whilst the zodiac past the meridian from $23^{\circ}\frac{1}{2}$ of Sagittary to 14° of Capricorn: and again (p. 52) he says that the constellation of Aries began to set with the 29th deg. of Pisces, and was wholly set with the 26th of Aries, whilst the zodiac past the meridian from 29° of Gemini to 29° of Cancer. He tells us also that it was the very same star that both rose and set first in that constellation, calling it δ ἐπὶ τῇ ἐμπροσθίῃ ποδῷ, p. 49: and again p. 52. 'tis named δ ἐν τοῖς ἐμπροσθίοις ποσίν, or that in the fore-feet of the Ram. This certainly is the star P. Souciet would place on the equinoctial colure, and makes it long since to have disappeared; without enquiring whether the aforesaid data were not abundantly sufficient to determine its place in the zodiac at that time; and without regard to the odd uncouth posture he must suppose the constellation of Aries to be in, when he makes one or both of the fore-feet so near to, and above the horn or ear. Hipparchus expressly says that it rose when $23^{\circ}\frac{1}{2}$ of Sagittary was on the meridian, and set when 29° of Gemini past it; and taking the middle between those points, it is plain that it culminated with about 26° of Pisces, and that it had north declination; the excess above 180° shewing that the ascensional difference was about $2^{\circ}\frac{1}{4}$. But to give the argument its full scope, the right ascension of $23^{\circ}\frac{1}{2}$ of Sagittary (allowing Hipparchus his obliquity $23^{\circ} 51' 20''$) will be found $262^{\circ} 54'$; and that of 29 degrees of Gemini will be

be thus $88^{\circ} 54'$: so that this star was above the horizon (in the latitude of 36° north, to which Hipparchus has adapted his calculation) $12^h 24'$ or 186° ; whence the right ascension of the star is justly concluded $355^{\circ} 54'$; and its ascensional difference precisely 3° ; which in that latitude makes its declination $4^{\circ} 7'$ north. We have therefore got both the right ascension and declination of this supposed first star of Aries. Let us now see what longitude and latitude results from the aforesaid right ascension with $4^{\circ} 7'$ north declination, assuming the obliquity with Hipparchus to have been $23^{\circ} 51' 20''$; and we shall find the star at that time to have been in $27^{\circ} 53'$ of Pisces, with $5^{\circ} 24'$ north latitude, which therefore was reckoned the place of the star at that time by Hipparchus. Add $2^{\circ} 40'$, for 265 years between Hipparchus and Ptolemy, and we shall have its place in Ptolemy's account Aries $0^{\circ} 33'$, with $5^{\circ} 24'$ north latitude. But the 22d star of Pisces in Ptolemy's catalogue has the same longitude and latitude with sufficient exactness, viz. Aries $0^{\circ} 40'$, with north latitude $5^{\circ} 20'$, and is media trium in lino boreo Piscium ($\star$ Bayero.) Hence it cannot be doubted but that this star which P. Souciet takes to have been once a star of the first magnitude, was no other than the said 22d of Pisces, which in the British catalogue fitted to the year 1690 is put down in Aries $22^{\circ} 29' \frac{1}{2}$ with north latitude $5^{\circ} 21'$. How Hipparchus came to reckon this star to be in the fore-foot of Aries does not at present appear; but it is not unlikely that these commentaries of his upon Aratus were written some time before he set about making his catalogue of the fixt stars; when he might change his opinion and replace it in the line of the fishes, to which it seems more properly to belong. Be that as it will, we will for once suppose with P. Souciet this star to have been in the beginning of the zodiac, or of the constellation of Aries, and that at the time of the first fixing the colures that of the vernal equinox past 15° in consequence thereof. Now anno ineunte 1690 this star being in Aries $22^{\circ} 29' \frac{1}{2}$, if we add thereto 15° we shall have Taurus $7^{\circ} 29' \frac{1}{2}$ for the point in the ecliptic that was then the beginning of the zodiac. Now $37^{\circ} \frac{1}{2}$ at $50''$ per annum gives 2700 years; from which deducting 1690 we shall have 1010 years before Christ. But this star having $5^{\circ} 21'$ north latitude, the colure when it past over it intersected the ecliptic in $2^{\circ} 20'$ less longitude, which gives the time 168 years later, or but 842 years before Christ. So that malgré cette grande decouverte the new system of chronology is so far from being refuted, that it seems to be very much confirmed thereby, at least in the opinion of the R. Pere.

I have assumed the latitude to which Hipparchus adapted his calculations to be 36° degrees; because I find in p. 14. of the aforesaid edition that he makes the longest tropical day 14 h. 30': and in p. 29 he tells us, that the southern star in the left foot of Bootes ($\star$ Bayero) having $27^{\circ} 20'$ north declination, was above the horizon 14 h. 57'; whence it follows that the latitude must be $36^{\circ} 5'$. He also tells us, in the

same p. 29, that this star set when 22° of Capricorn culminated and 6° of Taurus ascended, repeating the same thing in p. 39; which leaves no room to suspect that those numbers are not the same that Hipparchus had computed. I therefore thought it worth while to enquire in what latitude 6 degrees of Taurus rises when 22 degrees of Capricorn is on the meridian; and with the obliquity of the ecliptic as now we have it, the latitude resulting is $35^\circ \frac{1}{2}$ north; but with the obliquity allowed by Hipparchus it will be found less than 35° . This I say only to obviate any objection that may be made by P. Souciet to the foregoing argument; though if he please to examine it he will find that an error of a degree in the assumed latitude will by no means invalidate the proof here given, that this first star of Aries could be no other than the middle star in lino boreo Piscium, marked γ by Bayer.

Of the equuleus, or wooden horse of the ancients. By Mr. John Ward. n. 412. p. 231. Jan. Et. 1730.

III. **I**N quem finem equuleus primo institutus fuerit & ad quem usum adhibitus ex multis veterum scriptorum locis satis manifesto constat. Formam autem atque fabricandi rationem cum nemo eorum descripserit, in varias de hac re sententias easque haud parum a se invicem discrepantes doctissimi homines abierunt. Neque hoc mirum profecto ei videbitur qui quam difficile haud raro sit de rebus per multa secula desuetis & a conspectu remotis certi aliquid statuere secum perpenderit; idque praesertim si antiqui auctores qui eas commemorant leviter tantum id faciant, nec plene describant. Quod cum equuleo, ut dixi, evenerit; nec ullus eruditorum qui post renatas literas hanc machinam nobis explicare suscepit rem adeo feliciter expediisse mihi videretur ut descriptio cum iis quae veteres de illa tradunt per omnia congrueret; certius atque exploratius aliquid assequendi ipem omnem prorsus abjeceram. Ceterum inter chartas quasdam Roma transmissas, in quibus variae imagines antiqui operis jam illic extantes delineatae sunt, quas vir eruditissimus R. Meadius haud ita pridem mihi conspiciendi copiam praebere dignatus est, in unam forte fortuna incidi a marmore anaglyptico in palatio Principis Burgesii adservato descriptam, quae, ut statim conjectabar, hominem in equuleo suspensum exhibuit. Hujus igitur usu mihi perhumaniter concesso rem totam attentius considerare, loca apud veteres scriptores in quibus equulei mentionem faciunt studiosius exquirere, & cum hac imagine diligenter conferre coepi: unde tandem evenit ut non solum omnes qui seculis recentioribus de equuleo tractaverant a vero aberrasse, sed & causas quoque errorum, ut mihi videbatur, plane perspexerim. Quorum utrumque ex iis quae de antiqua hac machina jam dicturus sum, ni fallor, manifesto apparebit.

Equuleus igitur, si ad vocis originem attendamus, pullum equinum vel parvum equum significat, ut ex his Tullii verbis intelligimus: "Chrysippus omnia in perfectis & maturis docet esse meliora; ut in equo quam in equuleo." Atque hinc formam pariter ac nomen

* De N. D. l. 2. c. 14.

machina de qua agimus primo accepit. Equuleum autem cum cruce nonnulli minus recte confuderunt. Crux enim patibulum fuit, cui servi affixi alique abjectæ conditionis homines ultimo supplicio afficiebantur. In equuleo autem quæstiones vi tormentorum habebantur ad crimina eruenda. Sic Val. Maximus de servo quodam meminit qui sexies in equuleo tortus culpam pernegavit; & nihilominus a iudicibus postea damnatus & in crucem actus est ^b. Nec forma igitur nec fine instituto equuleus cum cruce conveniebat. Inter varias autem de equuleo sententias duas tantum, utpote quæ propius ad veritatem accedunt, hic memorabo. Altera est Hieron. Magii (quem sequitur Gallonius ^c) qui ad equi imaginem factum recte iudicavit ^d; altera vero est Caraccioli, qui stipitem erectum fuisse haud minus recte censuit ^e. In eo autem utrumque lapsum esse (ut de aliis erroribus taceam) quod unam semper formam habuisse existimaverint jam demonstrare conabor.

Seculis igitur antiquioribus equuleum ad equi imaginem quodam modo fabricabant, dorso in eam longitudinem ac latitudinem complanato ut hominem in illud porrecto corpore impositum satis convenienter capere posset. Qui torquendus enim erat non infidebat, sed brachiis sub equulei pectore retortis, vinctis manibus, pedibusque protensis, jacebat supinus. Duabus etiam trochleis diversæ magnitudinis equuleum instruebant; quarum minor inter clunes in hunc finem excavatos, major vero eademque manubriata sub ventre collocabatur. Tortor autem cum utrumque pedem funiculis vel nervis (qui fidiculæ dicebantur) ligasset, hos deinde contorquens ac per trochleam minorem ducens majori affixit; tum majorem hanc trochleam manubrio circumagens corpus eo usque extendere potuit, dum artus atque ossium compagines haud sine maximo dolore luxarentur. Jam veterum scriptorum testimonia quibus hæc descriptio confirmari possit profereamus. Formam igitur equinam ratio nominis (ut supra observatum fuit) aperte satis indicare videtur; sicut apud nos hodie simile quoddam instrumenti genus, quod vocamus the wooden horse, ad pœnas militares adhibetur. Idem quoque locutiones istæ declarant quæ ab equo desumptæ de equuleo pariter usurpantur. Ita non tantum conjici & imponi, sed etiam ire in equuleum apud Ciceronem legimus ^f. Atque hinc Pomponii jocus in versibus Atellanicis:

Et ubi insilui in cocleatum equuleum,

Ibi tolutim tortor s.

Ubi voces insilire & tolutim ab re equestri aperte traxit poeta. Porro cum cocleatum [legerem trochleatum] equuleum dicit, cocleis vel trochleis fuisse instructum ostendit. Homines autem in equuleo jacere solitos docet Seneca, cum ait: "Hoc nobis persuadere conaris, nihil

^b L. 8. c. 4.

^c De SS. Martyrum cruciat. c. 3.

^d De equul. c. 1.

^e Aquad Ferrar. Elect. l. 1. c. 5.

^f Tusc. Qu. l. 5. c. 5.

^g Apud Non. in voc. tolutim.

“interesse utrum aliquis in gaudio sit an in equuleo jaceat ^h.” Quin & fidiculis corpus fuisse extensum testis est Fabius, apud quem pater quod filium torquendo occiderat accusatus ita loquitur: “an tu quæstionem illam fuisse credis qualis vernilibus corporibus adhibetur? Ideo enim equuleum movebam artifex senex, tendebam fidiculas ratione sævitiae, ut leniter sedibus suis emota compago per singulos artus membra luxaret ⁱ.” Unde etiam Seneca hominem in equuleo longiorem fieri dicit ^k. Atque ut ea de causa manus pedesque adstringi necesse erat, sic illa qua diximus ratione id factum fuisse infra ostendemus. Huic autem equulei descriptioni quod de Zenone philosopho traditur adprime convenire videtur. Is enim, “cum a Nearcho tyranno torqueretur, doloris victor sed ultionis cupidus, esse dixit quod eum secreto audire admodum expediret; laxatoque equuleo, postquam insidiis opportunum tempus animadvertit, aurem ejus morfu corripuit, nec ante dimisit quam & ipse vita & ille corporis parte privaretur ^l.” Jam homo in equulei dorsum, ut supra explicuimus, jacens tanto spatio ab humo distabat ut ori ipsius alius commode satis aurem applicare posset; ideoque cum fidiculas tortor laxasset, attractis parum pedibus & capite inflexo aurem ejus morfu facile corripere. Porro verisimile videtur æneum taurum quem confecit Perillus & Phalaridi obtulit hinc ortum suum habuisse. Ab hoc enim crudelissimo tyranno homines *σεβλάσαι* solitos testantur Plutarchus ^m & Ælianus ⁿ; qua voce Ælianus equulei extensionem intellexisse ipse alibi ostendit ^o. Sic in Glossar. Philoxeni, *σεβλατής* equuleus. Cum peritus igitur iste sceleris artifex, Perillus, homines in equuleo tortos gemitibus suis & ejulatibus sonitum taurorum mugitui non prorsus absimilem edere observasset; quo artis adjumento res quam proxime adsimilari posset, de equina effigie in taurinam mutanda hominibusque ei includendis primum cogitasse haud absurde credatur.

Ceterum equina ista species non semper, ut diximus, equuleo permansit; sed posteris ætatibus in aliam longe diversam fuit mutata. Forma autem conversa ut idem nomen retineret huic machinæ cum multis aliis rebus fuit commune. Nam, ut alias omitam, machina ista bellica quæ ab arietini capitis similitudine aries dicebatur non eam perpetuo speciem habuit unde ab initio nomen accepit ^p. Equuleus igitur hisce temporibus stipes erat in altum erectus; cujus summæ parti lignum transversum atque cornuum more utrinque curvatum impositum eminebat. Duplici etiam trochlea, ut prior iste, instruebatur; minori imæ parti stipitis ad eam recipiendam excavatæ inserta, ac majori manubriata poneque affixa. Torquendus autem homo in equuleum sublatus, brachiis in lignum transversum retortis manibus-

^h Epist. 66.ⁱ Declam. 19.^k Epist. 67.^l V. Max. l. 3. c. 3.^m Parall. c. 39.ⁿ Var. Hist. l. 2. c. 4.^o Apud Suid. in voce *σεβλατής*.^p Vid. Lips. Poliorcet. l. 3. dial. 1.

que post tergum stipiti devinctis, pendebat; fidiculis etiam pedes ligabantur, quas per trochleam deinde minorem transmissas major averſæ equulei parti affixa recipiebat, cujus circumactu corpus extendebatur. Cum de hac autem equulei ſpecie veteris eccleſiæ ſcriptores, qui martyrum acerbiffimos cruciatus ſub Romanis imperatoribus literis conſignarunt, ſæpiſſime mentionem faciant; eorum potiſſimum teſtimoniis utemur in forma illius demonſtranda: Stipitem inter alios S. Hieronymus appellat¹. Item Prudentius:

Jubet amoveri noxialem ſtipitem².

Atque in altum fuiſſe erectum ex eo apparet quod torti homines in illo ſuſpendi ac pendere dicebantur; ut ex Eusebii & Prudentii verbis mox adducendis videbimus. De ligno tranſverſo nihil apud antiquos auctores invenio; quod multis eruditorum allucinationibus in hac machina deſcribenda cauſam dediffe fas eſt ſuſpicari. Sed in imagine quam delineatam exhibuimus lignum illud bicornè plane conſpicitur. Trochleis quoque inſtructum fuiſſe ex illis Eusebii verbis colligi poſteſt: “ Quidam, manibus poſt tergum revinctis, ad ſtipitem ſuſpen-
“ debantur, ac membrum unumquodque *μαγγάνοις* quibuſdam diſten-
“ debatur³.” Ubi vocem *μαγγάνοις*, quæ machinæ cuiſcunque fere nervis aut manubrio inſtructæ convenit, plurali numero adhibens trochleas ſignificare videtur. Porro ut manus poſt tergum vinctas fuiſſe hic docet Eusebius; ſic brachia retorta memorat Prudentius, ubi judicem ita imperantem inducit:

Vinctum retortis brachiis

Surſum ac deorſum extendite,

Compago donec offium

Divulſa membratim crepet⁴.

Item pedes vinciri ſolitos ex alio ejuſdem poetæ carmine apparet, in quo martyr ex equuleo ſic loquitur:

Miſerum putatis quod retortis pendeo

Extentus ulnis, quod revelluntur pedes⁵.

Quo pedes autem revelli poſſent prius adſtringi debebant. Ex utriuſque etiam ſcriptoris verbis ſtipitem, ut diximus, erectum fuiſſe apparet. Atque hinc judex ſurſum ac deorſum eodem tempore corpus extendi jubet. Etenim hac corporis poſitione, dum pedum revulſu inferiores ejus partes deorſum extenderentur, humeros tranſverſo ligno ſuffultos nexuque manuum ad ſtipitem repreſſos ſurſum protrudi atque luxari neceſſe erat. Et quia ab humo elevati pendebant, hinc apud Sozomenum præſes Chriſtianum hominem in equuleo torquendum *αλαγειῶσαι*, ſublimem tolli, præcipit; cui is, latera nudans, non opus eſſe inquit ut lictores ipſum in equuleum levando ac poſtea deponendo fruſtra defatigentur⁶. Imo quo poenæ conſpectiores eſſent equuleos in cataſta

¹ Epist. ad Innoc. 49.

² Πρὸς τὸν Εὐφ. Hymn. 10. v. 114.

³ Hist. Eccles. l. 8. c. 10.

⁴ Ubi ſupra, Hymn. 5. v. 109.

⁵ Ibid. Hymn. 10. v. 494.

⁶ Hist. Eccles. l. 5. c. 2.

fuisse constitutos haud male sensisse videtur Ferrarius⁷; de qua martyris verba apud poetam jam sæpius laudatum intelligi posse observat:

Emitto vocem de catasta celsior².

Quibus & illa, ni fallor, ejusdem carminis adjungi possint:

Incensus his Asclepiades jusserat

Eviscerandum corpus equuleo eminus

Pendere³.

Catasta autem pegma vel tabulatum est, in quo apud nos quoque ii collocantur quibus numellæ pœna infligitur. Sigonium^b igitur aliof. que viros doctissimos catastam de ipso equuleo perperam accepisse censet Ferrarius. Et revera, ni equuleus in catasta collocatus esset, qua ratione corpus in eo eminus pendens tortores ungulis suis ferreis eviscerare possent? proinde fidiculas ad corpus extendendum in hac forma equulei æque ac priori adhibitas fuisse ex codice Justiniani discimus; ubi Valentiniani imp. edicto “decuriones exsortes omnino earum esse pœnarum quas fidiculæ & tormenta constituunt” jubentur^c. Hisce autem verbis equuleum veteres haud raro describere satis notum est.

Jam si verba & locutiones quæ diversis temporibus equuleo tributa sunt paulo attentius consideremus, eidem formæ nequaquam congruere necessario fateri cogemur. Primum enim ex novo adjecto nomine formæ mutationem colligere licet. Nam vox stipes machinæ ad equi imaginem factæ nullo modo convenire potuit. Quare aut effigiem equinam, contra certam vocis equulei interpretationem ac veterum locutiones ab illa desumtas, nunquam habuisse dicendum est; aut cum stipes deinceps vocari cœpit aliam formam accepisse. Præterea antiquius jacere, postea vero pendere & suspendi in equuleo homines dicuntur; qui duo corporis situs tam longe diversi formam machinæ haud minus diversam requirunt. His accedit quod alteri formæ alterum effectum adscribi videtur. Vetusioribus enim seculis corpus simpliciter extendi dicitur, utpote in planum porrectum; sequentibus vero ætatibus sursum ac deorsum, quod pendenti convenit, id fieri jubetur. Denique in priori equuleo homo decumbens ea fuit altitudine ut in aurem alicui susurrare posset; quod in posteriori suspenso propter nimium a solo spatium haud omnino congruit. Et quis jam non videt hanc verborum ac locutionum discrepantiam ad duplicem equulei speciem necessario referendam esse? Certe homines isti eruditi qui aliter senserunt dum omnia apud veteres de hac re loquendi genera sententiæ suæ accommodare conati sint, eis difficultatibus fuerunt impliciti unde nullo modo sese explicare potuerunt. Verum ne qua hoc in dubium vocandi ansa in posterum restet, duo testimonia ex iis temporibus quibus stipitis formam equuleo supra tribuimus a Gallonio in contrarium allata^d breviter diluamus. Alterum ex illis S. Hieronymi

⁷ Elect. l. 1. c. 6.

^b De Judic. l. 3. c. 17.

² Ubi supra, Hymn. 10. v. 467.

^c L. 16. de quæst.

³ Vers. 108.

^d De SS. Martyr. cruciat. c. 3.

verbis petitur: "Cum equuleus corpus extenderet & manus post tergum vincula cohiberent, oculis, quos tantum tortor alligare non poterat, suspexit ad cælum ^e." Ex quo loco necesse esse ut in equuleo torti corpore prostrati jacerent contendit Gallonius. At nemo non clare perspiciet hominem eo modo quo diximus suspensum æque facile ad cælum suspicere posse ac si corpore supino jaceat. Alterum testimonium ex Amm. Marcellino adducitur: "Innocentes tortoribus exposuit multos, vel sub equuleo cepit [rectius Valesius caput] incurvos, aut ictu carnificis torvi substravit ^f." Et alibi: "Quamquam incurvus sub equuleo staret ^g." Unde idem vir doctus novum quoddam & inauditum cruciandi genus excogitavit; quasi tortores nonnunquam doloris augendi gratia, laxatis funiculis, corpus sub ventrem equulei cadere atque ibi incurvatum pendere sinerent. Verum non sub equuleo cecidisse vel pependisse dicit Ammianus, sed stetisse: quod qua ratione cum Gallonii sententia convenire possit non intelligo. Sed quia mos fuit eos qui in equuleo torquendi erant prius flagellis verberari, incurvus fortasse dixit quod verberibus laceratus recto corpore stare amplius non potuit; idque sub equuleo, hoc est, juxta equuleum; ut cum dicitur, sub hasta venire ^h: quod de voce etiam incurvos in altero Ammiani exemplo pari ratione dici potest. Ni quis potius de catenis onustis earumque pondere incurvatis voces istas intelligere malit; quemadmodum & in re simili scribit Paulinus Aquitanus:

Mœstorum pallens infelix ordo reorum

Hærebat, nexis per squalida colla catenis,

Incutiens fractis stridentia vincula membris,

Et motans tardos, incurvo pectore, gressus ⁱ.

Hic voces "incurvo pectore" eodem sensu quo Ammianus caput incurvos usurpasset videtur. Nonnullos etiam ex hoc infelici ordine equuleo destinatos fuisse post pauca significat.

Ast alii sursum porrecti robora ligni,

Triste ministerium, furioso corde parabant;

Ut caro distentis propere, male pendula, membris

Tortori laceros crucianda exponeret artus.

Ubi etiam verba "sursum porrecti robora ligni & caro pendula," erectam equulei formam plane demonstrant. Ceterum cum neque verberibus neque membrorum extensione ut rem quæsitam confiteretur homo tortus evinci potuit, ignes & ardentes laminæ ævis antiquioribus corpori admovebantur. Ita Fabius rem totam ordine recitans: "Ego scindo vestes, tu intremiscis; ego ad flagella nudo corpus, te facit pallor exanimem; ego equuleos, ego posco flammæ; tu non habes in meo dolore patientiam ^k." Et V. Maximus: "Rupit verbera, fidiculas laxavit, solvit equuleum, laminas extinxit, prius-

^e Epist. ad Innoc. 49.

^f L. 26. c. ult.

^g L. 28. c. 1.

^h Liv. l. 5. c. 16.

ⁱ De vit. B. Martini l. 5. v. 261.

^k Declam. 7.

“quam efficere potuit ut tyrannicidii socios indicaret¹.” Sequentibus autem seculis, cum jam stipitis speciem equuleus recēperat, hisce omnibus torquendi modis ungulæ etiam ferreæ adjiciebantur, quibus latera & aliæ corporis partes laniari solebant. Sic in codice Justiniani præcipitur: “Si convictus fuerit, & ad proprium facinus detegentibus repugnaverit pernegando, sit equuleo deditus, ungulisque sulcantibus latera perferat pœnas proprio dignas facinore^m.” Attamen quo tempore hæc formæ immutatio inter Romanos fieri cœperit pro certo affirmare nequeo. Ad Fabii saltem ætatem hoc est, imperium Domitiani, speciem mansisse equinam eo credibile videtur quod pater, qui in declamatione supra citata ob filium a se tormentis occisum defensionem sibi instituit, tanquam jacentem in cruciatibus illum describit. Ratio autem mutationis satis, opinor, probabilis adferri potest. Inferioribus enim Romani imperii ætatibus non tantum Christianos, sed alios etiam eximiæ dignitatis homines majestatis crimine postulatos, equuleo traditos fuisse sæpius legimus. Quamdiu autem in quæstionibus jure constitutis solum adhibebatur, nihil amplius erat necessarium quam ut ea quæ a reo dicerentur ipsi judices aliique quorum interesset exaudire possent; cui proposito forma equina satis conveniebat. Postea vero cum crudelissimis istis tyrannis ad suspicionibus suis indulgendum atque Christianos vexandum hac machina abuti placuit, erecta forma sine dubio omnium fuit commodissima. Nam ita crucis speciem quodam modo referebat, quo major pœnæ esset ignominia; & præterea homo tortus oculis circumstantium ad alios deterrendos magis exponebatur. Apud Græcos sane, unde Romani acceperunt, figuram equinam in usu fuisse cum Perilli taurus tum etiam Zenonis historia supra memorata manifesto satis declarare videntur.

Verum enimvero ut discrimen inter hæc duas machinas clarius patefcat, ac melius inter se conferri possint, utriusque imaginem hic conjunctim exhibemus.

Fig. 1.

Fig. 1. Prior forma equulei.

Fig. 2.

Fig. 2. Posterior forma equulei.

Priori adstat tortor majoris trochleæ manubrium tenens, quo hominem in dorsum equulei impositum extendat. Posterior autem, quam a clarissimi Meadii exemplari delineatam dedimus, tres humanas figuras habet adjunctas; quarum una est hominis in equuleo suspensi, duæ reliquæ sunt tortorum. Ex his alter, chlamyde (quam vestem tortori etiam tribuit Hieronymusⁿ) ab lævo humero pone rejecta, dextrum equulei cornu dextra prehendit quasi recte aliquid compositurus; alter vero, utpote prioris adjutor, nudus, ac genu nixus, ad pedes torquendi hominis vinciendos se parat. Quod sinistrum autem equulei cornu dextro sit brevius injuria temporis accidisse credamus; quia summa pars plane abrupta esse videtur. Quædam aut ipse artifex

¹ L. 3. c. 3.^m L. 7. de malefic.ⁿ Ubi supra.

aut saltem delineator omisit. Etenim nec inferior pars stipitis, ubi conspici posset, nec trochlea ad imum conspicitur: nam alteram trochleam pone collocari solitam supra notavimus. In eo autem alteruter manifesto erravit, quod hominem in equuleo ita constituerit ut pedum digitis solum tangere videatur; quod neque pendenti neque veterum testimoniis de hac re supra adductis omnino convenit. Sed vetustis hujusmodi monumentis haud raro accidere invenimus ut partes præcipuas & quæ summam operis continent artifices diligenter ac studiose effinxisse contenti, reliquas vel prorsus neglexerint vel minus saltem accurate expresserint. Ceterum ne quis ea diutius frustra requirat quæ in exemplari desiderantur; seorsim delineata oculis subjecimus una cum tortore trochleam convertente fig. 3. Arcus autem qui juxta hominis suspensi caput sinistrorsum conspicitur nihil cum equuleo habet commune; sed ostii alicujus partem, carceris forsan unde productus fuit, exhibet.

Fig. 3.

Jam si duplicem hanc equulei formam ac singulas partes inter se conferamus, eundem plane torquendi modum sub diversa specie utriusque fuisse facile videbimus. Si priorem enim ad equi imaginem factam in altum modo erectam mente concipiamus, trochleæ, fidiculæ, retorsio brachiorum, & totius corporis extensio, haud aliter atque in posteriori constitui apparebunt. Præterea nihil difficile, nihil operosum videtur; sed facilis & expedita cruciandi ratio nobis se offert, quæ in publicis suppliciis præcipue requiritur.

At nequis post omnia quæ hætenus dicta sunt, furcam, hoc est, crucem ad furcæ imaginem factam, pro equuleo nos protulisse suspicetur; sciendum est hanc equulei speciem furcæ non admodum fuisse dissimilem. Hoc Theophili cujusdam verba a Gallonio plane contra sententiam suam allata demonstrant: "Ecce," inquit, "modo Christianus sum, quia in cruce, id est in equuleo, suspensus sum. Equuleus enim crucis quandam similitudinem gerit." Nihilominus tamen furca in multis ab equuleo differebat. Primum enim ima pars cornuum ad formam V literæ in acumen coibat; deinde cornua multo erant longiora; præterea, qui in furcam agebatur brachiis supra caput, non post tergum, retortis pendebat; denique manus haud stipiti conjunctæ, sed cornibus dispanfæ ligabantur, ut ostendit Lipsius^p. Et tamen alibi vir idem eruditissimus Aufonii verba de Cupidine torto cruci assignat^q, quæ ad equuleum omnino referri debent. Locus Aufonii ita se habet:

Hujus in excelsso suspensum stipite Amorem,
Devinctum post terga manus, substrictaque plantis
Vincula mœrentem, nullo moderamine poenæ
Adfligunt^r.

Cum poeta hic ait, "devinctum post terga manus", non crucem sed

^o De SS. Martyr. cruciat. c. 3.

^p De cruce, l. 3. c. 6.

^q Ibid. l. 1. c. 5.

^r Edyll. 6.

equuleum plane describit. Porro cum Sulpicius Severus de B. Martino loquens ait gloriam martyris eum adeo affectasse ut, si licuisset, "equuleum sponte ascendisset"^f; machinæ figura ac ratio suspensionis quemadmodum id facere potuisset aperte satis ostendunt: in furca autem se ipsum nemo suspendere potuit.

In summa autem, cum tota hujusce rei probatio veterum scriptorum testimoniis præcipue nitatur, ut plura adferre quæ haud parva copia sese obtulerunt, supervacaneum duximus; ita nec pauciora ad plenam ejus explicationem sufficere existimavimus. Verum quæcunque de ea apud antiquos leguntur, uni aut alteri speciei supra descriptæ facile tribui possunt. Qui ad auctoris igitur ætatem & diversos loquendi modos diversis temporibus de equuleo usurpatos attenderit, nihil, opinor, difficultatis in posterum inveniet quid de hoc tormenti genere statuere debeat; in quo explicando tot viri eruditi hætenus se frustra torserunt.

*Of the Styli,
and sorts of
paper used by
the ancients.
By Rog. Gale
Esq; n. 420.
p. 157. Aug.
6c. 1731.*

IV. **T**His curious paper is extracted from a treatise written by the Hon. Sir John Clerk, entitled, "De styliis veterum, & diversis chartarum generibus": in which the learned and judicious author takes occasion from some antique brass implements found near the wall of Antoninus Pius, now named Graham's Dyke, in Scotland, to give us a curious dissertation upon the Stylus, an instrument used by the ancients for writing, with the figures of some of them annexed; two of which are represented in the shape and form of the Roman fibula, but the author is of opinion they were designed for a different purpose, for which he produces very cogent reasons.

He observes that before the use of pens the ancients wrote with an instrument called by them a stylus or Graphium. The matter of it was gold, silver, brass, iron, or bone; the shape various, but always pointed and sharp at one end, flat and broad at the other: the first for writing, or rather cutting their letters, the later for defacing or rubbing out whatever wanted correction; for all which, as well as for every thing else asserted by him, he produces sufficient proofs from proper authors. He informs us that the styli made of iron were sometimes used as daggers, and quotes two passages out of Suetonius to prove it; one where J. Cæsar is said to have wounded Cassius in the arm graphio; the other where he tells us it was customary with Caligula to get his enemies murdered graphiis when they came into the senate-house, and confirms these two passages by a third taken from Seneca's first book de clementia. He supposes the stylus made of bone was for the use of women and children, as less dangerous than those of metal; by a quotation from Prudentius it appears that Cassianus the martyr was killed by his scholars with iron styli. He agrees with Petavius, or his editors, that the implements which gave birth to this dissertation were styli, and not fibulæ ad connectendas

vestes, as Monfaucon and other antiquaries have imagined; and thinks an objection that the tongues of the styli must have been much longer than the tongues of their supposed fibulæ, to be of little weight; since they must have differed in length according to the different fancy of the writer. Military men might sometimes write with the point of their daggers, and from this practice the words stylus and pugio came to be confounded; but men of business and private persons cannot be supposed to have made use of daggers for writing. He observes also, which is no small argument for his side of the question, that if Monfaucon had consulted the numerous draughts he has published of the habits belonging to the old Greeks and Romans, he would not have found one of these implements either as a fastening or an ornament upon them. He proceeds next to a description of these styli found in Scotland, and shews how they were accommodated to the business he supposes them designed for; but as the copper plate prefixed to his dissertation will give us a much clearer notion of that, I refer to it, and only take notice that the fifth figure in it is so intirely different from the others that he himself is in some doubt about it, and owns it might have served the aruspices in examining the bowels of animals, and have been one of those instruments called extispicia. However, he thinks that if he should pronounce it to have been a stylus he should not be much out of the way, since the ancients had their thecæ graphiaræ, which name will agree very well with this brass case and the instrument found within it. From the stylus used to form letters comes the figurative expression, that a person writes such or such a style, to denote his manner; which way of speaking our own and other modern nations have introduced into their language.

As to the several sorts of Charta used for writing, he observes the most ancient were made of barks of trees, or skins, or were such as are called Pugillares. The oldest were of the inner bark of trees called liber in Latin, whence a book had the same name; but very little of this sort is now in being, except the Ægyptian paper may be accounted one species of it. The Papyrus was called βύβλος or βύβλος by the Greeks, and thence their books βύβλοι or βύβλια. This sort of charta was made of a plant that had many pelliceous tunicles, as Pliny informs us, which were separated from one another by a needle, and then glued again together to give them a strength and firmness sufficient to retain what might be written upon them. Alexandria was the place most eminent for this manufacture. There are some fragments of this sort still extant in libraries, particularly the famous M. S. of St. Mark's gospel at Venice. The chartæ membranaceæ are made of the skins of animals, dressed either like our glove-leather or modern parchment. The first sort was commonly used by the Jews for writing the law of Moses, and from the rolling up of these skins comes the word volumen. But the skins which Varro and Pliny say were first made by Eumenes king of Pergamus

were in more common use: however, Eumenes, who is related by these authors to have made them in opposition to Ptolomy king of Ægypt when he forbid the exportation of the papyrus from his dominions, does not seem to be the inventor of the chartæ membranaceæ; for Herodotus, who lived long before his time, informs us that the Ionians and other nations used to write upon goat and sheep-skins. Josephus also tells us that the Jews sent their laws written upon skins in letters of gold to Ptolomy; by which it seems the writing upon skins was no new thing at that time among the Jews. The use of the pugillares was also very ancient, being mentioned by Homer, and by Plautus. They were made of all sorts of wood, ivory, and skins covered over with wax. They were likewise of several colours, as red, yellow, green, saffron, white, and others. Being waxed over any thing was easily written upon them by the point of the stylus, and as easily rubbed out and altered by the flat part of it. Sometimes these pugillares were made of gold, silver, brass, or lead, and then there was a necessity of an iron stylus to write or cut the letters upon them, which explains that passage in Job ch. xix. *Quis mihi det ut exarentur in libro, stylo ferreo & plumbi lamina, vel certe sculpantur in filice.* They consisted sometimes of two, three, five, or more pages, and thence were called duplices, triplices, quintuplices, and multiplices; and by the Greeks, διπλῆ, τετρίπλῆ, &c. The diptychs and triptychs that were covered with wax served only for common occurrences, the other sorts received every thing else that was writ upon chartæ or membranæ, and were sometimes called by the Greeks palimpsestæ, from the rubbing out of the letters upon them. The chartæ linteæ and bombycinæ made of linnen or cotton were of a much later date; and from these we learned to make the paper now in use of linnen rags, an invention probably of about six hundred years standing. Writing was practised upon all these chartæ with a reed, and afterwards with a pen, except upon the pugillares. These reeds grew upon the banks of the Nile; the Greeks also used reeds imported from Persia for the same purpose. Calami argentei are also mentioned for writing.

Their letters were formed with liquors of various colours, but chiefly black, thence called atramentum, and in Greek μέλαν or μελάνιον. It was sometimes made of the blood of the cuttle fish, sometimes of foot. Apelles composed a black of burnt ivory, which was called Elephantinum. They had ink also from India of an approved composition, as Pliny says. The titles of their chapters and sections were written in red, or purple: hence the titles of the Roman laws are called Rubricæ. Their Purpura was an exceeding bright red or crimson, much in vogue with the Byzantine writers and called Κιννάβαρις; it was a liquor made of the Murex boiled and its shell very finely powdered; or as Pliny relates, of the blood of that fish. Almost all the ancient emperors wore this colour, their names were painted

painted in it upon their banners, and they frequently wrote with it and wore it. This colour was often the distinction of a Roman magistrate, and to put on the purple was the same thing as to assume the government. This colour was so admired by the poets that they called every thing which was very bright and fine, purple; as Horace complements the swan, which is never of any colour but white, with "purpureis ales oloribus." We find even snow honoured with the same epithet, whence some have imagined that purpureus signified white. The children of the emperors, and such as had a prospect of rising to the throne, and their guardians, sometimes wrote with green; gold also was employed for the like purpose. They that desire to see more upon this subject may have recourse to Mabillon de re diplomatica, and Monfaucon in his palæographia Græca.

V. **T**His inscription fig. 4. as curious as any yet discovered in Britain, was found the beginning of last April at Chichester, in digging a cellar under the corner house of St. Martin's-lane, on the north side as it comes into North-street. It lay about four foot under ground with the face upwards, by which it had the misfortune to receive a great deal of damage from the picks of the labourers as they endeavoured to raise it; for besides the defacing several letters, what was here disinterred of the stone was broke into four pieces: the other part of it still wanting, is in all probability buried under the next house, and will not be brought to light till that is rebuilt. The inscription is cut upon a grey Suffex marble, the length of which was six Roman feet, as may be conjectured by measuring it from the middle of the word **TEMPLUM** to that end of it which is entire, and is not altogether three foot English, from the point mentioned. The breadth of it is two and $\frac{1}{4}$ of the same feet, the letters beautifully and exactly drawn, those in the two first lines three inches long, and the rest 2 $\frac{1}{4}$.

A Roman inscription found at Chichester. By the same. n. 379. p. 391. Sept. &c. 1723. Fig. 4.

Being at Chichester in September last with Dr. Stukely, we took an accurate view of this marble, which is now fixed in the wall under a window within the house where it was found; and that we might be as sure of the true reading as possible, wherever the letters were defaced, we impressed a paper with a wet sponge into them, and by that means found those in the fifth line to have been as we have expressed them above, and not as in other copies that have been handed about of this inscription. The only letter wanting in the first line is an N before **EPTVNO**, and so no difficulty in reading that. As to the second, though it was more usual in inscriptions of this nature to express the donation by the word **SACRVM** only, referring to the temple or altar dedicated; yet we have so many instances in Gruter's corpus inscriptionum of **TEMPLVM** and **ARAM** also cut on the stones, that there is not the least occasion to say any thing farther upon that point. The third line can be no other way filled up, than as I have done it by the prick'd letters: I must own, however, that

I have

I have had some scruple about the phrase of DOMVS DIVINA, the same thing as DOMVS AVGVSTA, the Imperial family, which I cannot say occurs with any certainty of the time it was used in before the reign of Antoninus Pius, from whom, down to Constantine the great, it is very frequently met with in inscriptions. This kept me some time in suspense, whether this found at Chichester could be of so early a date as the time of Claudius: but as we find several inscriptions in Gruter with those words in them, or I. H. D. D. In honorem domus divinæ, which is much the same thing, without any mark of the time when they were cut, they may have been before the reign of Antoninus Pius, and then only came into more general use; and as the time that Cogidunus lived in will not let this be of a later standing, I think we may offer it as an authority for the use of this piece of flattery to the emperors long before that excellent prince came to the purple. The third line, as I believe, was EX AVCTORITATE. TIB. CLAVD. and the fourth COGIDVBN. R. LEG. &c. that is, "Ex auctoritate Tiberii Claudii Cogidubni regis, Legati Augusti in "Britannia," for the following reasons. We are informed by Tacitus in vita Agricolaë[†], That after Britain had been reduced to a Roman province by the successful arms of Aulus Plautius, and Ostorius Scapula, under the emperor Claudius, "Quædam civitates Cogiduno "Regi erant donatæ, is ad nostram usque memoriam fidissimæ re- "mansit, vetere ac jam pridem recepta populi Romani consuetudine "ut haberet instrumenta servitutis & Reges." This Cogidunus seems to be the same person as Cogidubnus in our inscription, the letter B in the third syllable making little or no difference in the word, especially if pronounced soft, as it ought to be, like a V consonant.

It is so well known to have been the custom of the Roman Liberti and Clientes, to take the names of their patrons and benefactors, that it would be wasting of time to prove the constant usage of that practice. Now as this Cogidubnus, who in all probability was a petty prince of that part of the Dobuni which had submitted to Claudius, and one that continued many years faithful to him and the Romans[‡], had given him the government of some part of the island by that emperor, nothing could be more grateful in regard to Claudius, nor more honourable to himself, after he was Romanised, than to take the names of a benefactor to whom he was indebted for his kingdom, and so call himself TIBERIVS CLAVDIVS COGIDVBNVS. I suppose him to have been a Regulus of the Dobuni; because we are told by Dion Cassius^{*} that Aulus Plautius having put to flight Catratacus and Togodumnus sons of Cunobelin, part of the Boduni (the same people as the Dobuni) who were subject to the Catuellani, submitted to the Romans; and the name Cogidubnus, or Cogiduvnus, *Coc o Dubn*, or *Dubn*[‡], signifying expressly in the British language

[†] Cap. 14.[‡] V. Tacit. ut supra.^{*} In lib. ix.[‡] V. Baxteri Glossar. in verbis COGIDVBNVS. & DOBUNI.

PRINCEPS DOBVNORVM, seems to put the matter out of all doubt. How far his territories extended it is impossible to define. Bishop Stillingfleet ² supposes them to have lain in Surrey and Suffex; Suffex certainly was part of them, since the temple mentioned in this inscription was erected in it by his authority; and it is not unlikely that besides the Regni who were the people of those two counties, he might have that part of the Dobuni which had submitted to the Romans, and seems to have been his own principality, together with the Ancalites, Bibroci and Segontiaci, whose countries lay between the Dobuni and the Regni bestowed upon him; the words "civitates quædam" in Tacitus, importing no more than some few towns, but several people, the word Civitas always signifying a People in that historian.

Before I proceed any farther, it will not be amiss to observe, that Togodumnus and Cogidubnus, though their names are so much alike, were two distinct persons: the first was son of Cunobelin, king of the Trinobantes, vanquished and killed in battle by Aulus Plautius. The second a prince that submitted to Ostorius Scapula, and continued in his fidelity to the Romans, "in nostram usque memoriam" says Tacitus, who was born at the later end of Claudius's reign; so that Togodumnus was probably dead before Cogidubnus had his government conferred upon him. I call it his government, for though by the letter R standing in the inscription with a point both before and after it, by which it plainly denotes an entire word of itself, it may seem that it was intended for COGIDVBNI REGIS, and I believe was so in respect of his quondam dignity; yet it is evident that he had condescended to take the title of LEGATVS AVGVSTI IN BRITANNIA from Claudius; and that too must have been only over those people that he had given him the government of, Aulus Plautius, Ostorius Scapula, Didius Gallus, Avitus Veranius, and Suetonius Paullinus, having the supreme command successively about this time in this island, the second and last of which are called expressly Legati by Tacitus ³. The Legati Cæsaris or Augusti were those, "qui Cæsaribus subditas regebant provincias."

The sixth line has lost at the beginning the letters COLLE, but so much remains of the word as makes it to have been indubitably when entire COLLEGIVM, and the following letters are an abbreviation of FABRORVM. These colleges of artificers were very ancient at Rome, as ancient as their second king Numa Pompilius, if we may believe Plutarch ⁴, who tells us, that the people were divided by him into what we at this day call "Companies of Tradesmen," and mentions the *τέχνες* or Fabri among them, though Florus ⁵ says, that "Populus Romanus a Servio Tullio relatus fuit in censum, digestus in Classes, Curiis atque Collegiis distributus." But as the power

² Orig. Britan. p. 63.

³ Lib. xii. Ann. cap. 32. & Vit. Agric. cap. 15.

⁴ In vit. Numæ.

⁵ Lib. I. cap. 6.

of the Romans extended itself, it carried the arts of that great people along with it, and improved the nations that it subdued by civilizing and teaching them the use of whatever was necessary or advantageous among their conquerors, from which most wise and generous disposition, among other beneficial institutions, we find these Collegia to have been established in every part of the empire, from the frequent mention of them in the inscriptions collected by Gruter, Spon, and other antiquaries. Several sorts of workmen were included under the name of Fabri, particularly all those that were concerned in any kind of building, whence we meet with the "Fabri Ferrarii, Lignarii, "Tignarii, Materiarii, Navales," and others; the last named may have been the authors of dedicating this temple to Neptune, having so near a relation to the sea, from which the city of Chichester is at so small a distance, that perhaps that arm of it which still comes up within two miles of its walls, might formerly have washed them. The rest of the fraternity might very well pay the same devotion to Minerva, the goddess of all arts and sciences, and patroness of the Dædalian profession.

As no less than five letters are wanting at the beginning of the sixth line, there cannot be fewer lost at the beginning of the seventh, where the stone is more broke away than above; so that probably there were six when it was perfect. What we have left of them is only the top of an S; I will not therefore take upon me to affirm any thing as to the reading of them, which is so entirely defaced; perhaps it was A. SACR. S. "a sacris sunt;" perhaps it was HONOR. S. "Honorati sunt:" as to the former, we find these Collegia had their Sacerdotes, therefore "Qui a sacris sunt," which is found in inscriptions^d, would be no improper term to express them; or it might have been SACER. S. "sacerdotes sunt," since we find such mentioned in the following inscriptions^e.

MAVORTI SACRVM
HOC SIGNVM
RESTIT-----
COLL. FABR. ARI
CINORVM ANTIQVISS.
VETVSTATE
DILAPSVM ET
REFECER. CVR. L. LVCILIVS
LATINVS PROC. R.P. ARIC.
ET T. SEXTIVS MAGGIVS
SACER. COLL. EIVSD.

"Mavorti sacrum hoc signum restituit Collegium Fabrorum Aric-
"norum antiquissimum, vetustate dilapsum, & refecerunt. Curabant
"Lucius Lucilius Latinus, Procurator Reipublicæ Aricinorum, &
"Titus Sextius Maggus Sacerdos collegii ejusdem."

^d V. Grut. Corp. xxix. 8. cxxi. i. dcxxxii. i.

^e Spon. Miscell. Erud. Antiq. p. 58.

L. TERTENI AMANTI
SACER. COLL. LOTORVM
IIVIR. C. SARTIVS C. F.
ITERINVS ET L. ALLIVS
PETELINVS D. D.

"Lucius Tertenius Amantius Sacerdos collegii Lotorum, Duum-
viri Caius Sartius, Caii filius, Iterinus, & Lucius Allius Petelinus
Dedicaverunt."

As to the later, those members of the college that had passed through the chief offices of it, as that of "Præfectus, or "Magister
"quinquennalis," had the title of HONORATI conferred upon them: you have several of these HONORATI mentioned in Gruter, particularly a long catalogue of them "in Collegio Fabrorum Tignariorum," p. cclxviii. 1. and in Reinesius's Syntagma 'there is an inscription.

EPAGATHO TVRANNO
HONORATO COLLEGI
FABRVM TIGNARIORVM
ROMANENSIVM, &c.

So that the vacuity in our inscription may very well have been filled up with one or other of these words, and the three next letters that follow them D. S. D. "de suo dedicaverunt," will agree with either of them, and what precedes them.

The last Line has been PVDENTE PVDENTINI FILIO; but there must have been a letter or two of the prænomen at the beginning of it, unless it was shorter than the rest at that, as well as at the later end of it; and from what I have said, the whole may be read as follows.

"Neptuno & Minervæ Templum pro Salute Domus Divinæ, ex
"Auctoritate Tiberii Claudii Cogidubni Regis, Legati Augusti in
"Britannia, Collegium Fabrorum, & Qui in eo a Sacris [or] Ho-
"norati sunt, De suo Dedicaverunt, Donante aream Pudente Pu-
"dentini Filio."

Chichester, by this inscription found at it, must have been a town of eminence very soon after the Romans had settled there, and in process of time seems to have been much frequented, by the Roman Roads still visible, that terminate here from Portsmouth, Midhurst, and Arundel, tho', what is very strange, we have no Roman name now known for it. I once thought it might have put in its claim for Anderida, which our antiquaries have not yet agreed to fix any where, being situated very near both to the sylvæ Anderida, and the southern coast of the island, the two properties of that city: but Henry of Huntingdon, who lived in the time of Henry II. telling us that the Saxons so destroyed Andredecester, that "Nunquam

* Ibid. p. 64.

† Pag. 605.

‡ V. Camb. Brit. and Somner's Roman Ports

and Forts.

“ postea reedificata fuit, & locus tantum quasi nobilissimæ urbis
 “ transeuntibus ostenditur desolatus^b,” it could not be Chichester ;
 for that was not only rebuilt before his time, but was a place of such
 note that when the Bishops, soon after the conquestⁱ removed their
 churches from small decay’d towns, where several of them were then
 seated. “ in Urbes Celebriores,” Stigand then bishop of Selsey settled
 his episcopal chair at that place.

I shall conclude with observing, that when this inscription was dug
 up, there were also two walls of stone discovered close by it three
 foot thick each, one running north, the other east, and joining in an
 angle, as the North-street and St. Martins-lane now turn, which in all
 probability were part of the foundations of the temple mentioned
 on the marble.

*A Roman
 pavement
 found near
 Grantham in
 Lincolnshire,
 By Dr. W.
 Stukeley,
 n. 402. p.
 428. Apr. &c.
 1728.*

Fig. 5.

VI. 1. **I**N Feb. 1727-8. a Roman pavement in Mosaic work was
 found in the open fields of Denton about two miles and an
 half from Grantham. It lies partly in the glebe land, partly in Mrs.
 Welby’s, who assisted us with workmen to clear it. It has been a very
 large room about thirty foot both ways, as we found by digging in
 divers places; but being so near the surface not above a foot or a
 foot and half deep, and having been plow’d over time out of mind,
 the major part of it is ruin’d and imperfect. Besides many frag-
 ments of it, we had only the pleasure of viewing one piece entire,
 which was thirty foot long and six broad; and this was extremely
 pretty, the colours lively, the pattern or figure finely design’d, as you
 will see by the drawing, which is exactly taken in fig. 5. There are
 only three colours, white, red and blue; but of the middle or most
 beautiful part of it, which is but nine foot long and three broad,
 the white and red is double in quantity to the blue. In the outermost
 part or verge of the work there is no variety or colour, but it is en-
 tirely blue; and that made of much larger squares than the rest.
 On the east and west sides this was six foot broad, on the north but
 three. The red is formed out of Roman bricks, several fragments
 of which we found about the work; the white colour is made of the
 common lime-stone of our country; the blue of the stone that comes
 from Benyngton towards Newark five miles from this place: these
 colours wear well together and produce a good effect. In digging we
 found several parts of the foundations of the walls that terminated
 this room, and seemingly foundations of other rooms adjacent, which
 foundations were made of the common white stone of the country
 set on edge side by side, with here and there a bit of Roman brick.
 The building was plac’d parallel with the quarters of the heavens.
 They found in digging some human bones, and I took many bones of
 a hand which probably belong’d to some unfortunate person kill’d in
 the ruins, or when the house was demolished.

^b Pag. 312. V. Dr. Tabor’s Discourse of Anderida. Philosoph. Transf. N. 356
ⁱ A. D. 1076.

VI. 2. There

VI. 2. **T**HREE miles south of Grantham is great Paunton, a village set in a sweet valley, where the beginnings of the Witham river are collected from many springs a little higher. Hard by upon the edge of the hill runs the great Roman road call'd Hermen-street. This village I asserted in my itinerary to be the Causennis in Antoninus's itinerary, which commentators have found difficulty in settling. The terms or two towns between which it is placed in Iter V. with the distance of the miles sufficiently establish the situation, and they are well known and acknowledged; thus Durobrivas, Causennim m. p. xxx. Lindum m. p. xxvi. for Paunton is thirty Roman miles from Durobrivæ, or the passage of the Hermen-street over the Nen-river above Peterborough, and twenty six from Lincoln. At Paunton, since I came to live at Grantham, I have heard of much antiquity being found, especially Mosaic pavements; and undoubtedly it was the station upon the Hermen-street, between Brigcasterton twelve Roman miles off, and Ancaster seven, which were likewise Roman stations and wall'd about, but now their names are lost. All about Paunton the Romans inhabited very frequent, as at Kirkstoke particularly where great quantities of antiquities have been found; likewise at Strawston I have seen many Roman coins dug up, in possession of my neighbour captain Hacket, who owns the town. He says likewise subterraneous vaults have been found there, and near it is the place where our pavement was discovered. Between Paunton and Grantham a Road passes the river at Salter's Ford, this road is called Salter's gate, and much frequented. I believe it has continued ever since the Roman times, being the passage from Holland in Lincolnshire by Brigend causey, (a Roman work) to all the towns upon the Foss way in Nottinghamshire and Leicestershire: for along this way they carried salt made by the sea side to those mediterranean parts both in Roman and Saxon times. Our pavement stands within a bow-shot of this road upon very high ground, and seems to have been a summer-villa, or pleasure-house, where on one side they were entertained with the sight of travellers going on the road; on the other they commanded a most noble prospect northwards of a prodigious extent. When we are upon the spot, we may easily see the reason why they fixed it in that very point, the most delightful place that can be imagined for a summer-retreat. 'Tis placed just at the head of a convallis, or lesser valley falling down into the great valley of Denton underneath, from which Denton has its name, signifying the town in the valley. This convallis is extremely beautiful, and running northward must needs be very pleasant and cool in the summer-time. Our Villa had this further advantage in its situation, that it commanded a view between the opening or gap that in this place appears between Barrowby and Wolsthorp hills; which leads the eye into the boundless prospect of the vale of Belvoir. You see from hence Newark, the Trent, Kelham park and house, Southwell minster, the forest of Sherwood, &c. besides the

*Oeconomy of
the Roman
times near
Grantham.
By the same
ibid.*

neighbouring castle of Belvoir, where in these times was a Roman exploratory camp, likewise the Roman camp of Hunington; inso-much that we may well commend the wisdom and good taste of the builder, who contrived so well for security and pleasure. For air, the country hereabouts has always, and deservedly been reckoned the Montpelier of England; for water, wood, heath, and prospect, it may be thought the Frescati.

*Amendments
to the account
of things
found under
ground in
Lincolnshire.
By Mr. R.
Thoresby.*

n. 377. p. 344.

May &c. 1723.

† Vid. supra

Vol. IV. P. II.

C. III. §. XI.

VII. **I**N Phil. Transf. † N°. 279. pag. 1157. lin. 35. and pag. 1158. lin. 15, 16. there is some difference betwixt the accounts of the depth of the things found, that in the letter sect. 5. accounting it to be about eight or ten foot, and that in the letter sect. 4. to be twelve or fourteen foot deep; the reader may please to understand, that the depth was not measur'd, but conjectur'd, and accounted for according to the relator's best remembrance. That which makes the depth the greater being that of sect. 4. (first placed, but last wrote) was wrote upon information (but by conjecture also) of another that lived near the place, and viewed it often. But the difference may easily be accommodated or salved, by supposing (which will not be far from truth) that when the labourers or dikers first discovered and encountered the jetties and other things there found, it might be about the depth of eight or ten foot; but the bottom of them, when they came to be all taken up, might be at the depth of about twelve or fourteen foot, as in the other relation.

Take notice also, concerning what is said pag. 1159. lin. 14. that some very judicious persons say that the stones which the spectators saw at the bottom of Hammon Beek were such as the dikers had first thrown out, (when they were taking up the old goat) and were fallen in again. But that it was a hard and firm soil is certain; and probably that on which the famous steeple of Boston stands. See the record of the foundation of the said steeple in the Philos. Transf. numb.

† Vol. III. P. II. 223. p. 243 †.

C. III. §. I.

Fig. 6.

The form of the shoe soles found at Spalding was after this manner, fig. 6. each foot had its proper shoe: this was for the right foot. Now, by some passages in history, it may probably be conjectured, when those shoe soles were left there, and how long it may be since that atterration, which makes the present country, began; take an instance or two. In Stow's chronicle, ad An. 1465. we read of a proclamation against the beaks or pikes of shoone, or boots, that they should not pass two inches upon penalties there mentioned. And by other passages in history it appears that those pikes of shoes were before that time exceeding long and held up by chains, that they might not hinder the wearers going; which chains or ligaments were sometimes of silver, if not of gold, that they might be rich as well as ornamental. The other instance is this. In Melchior Adamus's life of Conrad Peltican, at the bottom of page 263, in the octavo edition there is this passage. "Illo ipso tempore (viz. an. 1484.) milites ex Flandria reversi

" multa

“ multa nova introduxerunt, nempe variegatas caligas, obtusos cal-
 “ ceos, qui antea acuti gestabantur a viris & mulieribus, simul quo-
 “ que novum sandaliorum genus obtusum, quod vocabant Pantoff-
 “ len, quibus suos etiam parentes uti conspexit, omiſſis paulatim
 “ calopodiis *Holſchuh* dictis: quæ quidem novitates interim immen-
 “ sum creverunt.”

Now by this account it appears, that it is not much above 200 years since those shoes, before described were worn; and consequently it cannot be much longer since the earth hath been raised there to the thickness before mentioned, viz. of ten or twelve foot; and since Bicker-haven grew up to be (as now it is) higher land than the country on each side of it. By which may be conjectured what a change a century or two more may make in the out-falls of the rivers of Witham, Welland; Nyne and Ouse; and consequently the necessity of taking some other method for preventing the impending mischiefs, which threaten the navigation of the said rivers, and those who have estates and interests in the great level of the fens, and are concerned about the draining of them.

VIII. **H**AVING view'd the ruins in Repton al. Repingdon on the Trent, and enquiring for antiquities, the inhabitants brought us Thomas Walker, a labourer eighty eight years old, who gave the following account. About forty years since cutting hillocks near the surface he met with an old stone wall, when clearing farther he found it to be a square enclosure of fifteen foot: it had been covered, but the top was decayed and fallen in, being only supported by wooden joists. In this he found a stone coffin, and with difficulty removing the cover, saw a skeleton of a human body nine foot long, and round it one hundred human skeletons of the ordinary size, laid with their feet pointing to the stone coffin. The head of the great skeleton he gave to Mr. Bowers master of the free-school. I enquired of his son one of the present masters concerning it, but it is lost; yet he says that he remembers the skull in his father's closet, and that he had often heard his father mention this gigantic corps, and thinks the skull was in proportion to a body of that stature. The bottom of this dormitory was pav'd with broad flat stones, and in the wall was a door-case with steps to go down to it, whose entrance was forty yards off, nearer the church and river. The steps are stone and much worn: 'tis in a close on the north side of the church, and over this repository grows a sycamore planted by the old man when he filled in the earth. The present owner will not suffer it to be open'd, the lady of the manor having forbidden it. This was attested to us by several old people who had likewise seen and measured the skeleton.

An human skeleton of an extraordinary size at Repton in Derbyshire, by Dr. Simon Degg. n. 400. p. 363. Oct. &c. 1727.

IX. A paper omitted.

AN explanation of the new chronological table of the Chinese history, translated into latin from the original Chinese, by father Joh. Fran. Foucquet Soc. Jes. bishop of Eleutheropolis, and published.

n. 415. p. 397.

published at Rome in the year 1730. Collected from two accounts thereof written in French, one sent from Rome by Sir Tho. Dereham Bart. to the Royal Society; the other sent from father Foucquet to father Eustache Guillemeau a Barnabite at Paris, and by him transmitted to Sir Hans Sloane Bart. Pr. R. S.

C H A P. II.

Miscellaneous Papers.

Mr. J. Ch. Le Blon's Principles of printing, in imitation of painting, and of weaving tapestry, in the same manner as brocades. By Dr. Cromwell Mortimer, n. 419. p. 101. June &c. 1731.

MR. Le Blon endeavouring to fix the true harmony of colouring in painting, found that all visible objects may be represented by the three primitive colours, red, yellow, and blue; for out of them all others even black itself, may be compounded. We are beholden to the great Sir Isaac Newton for the discovery of the difference of colours contained in the rays of the sun; and that the union of them all produces a white, which is light itself.

For distinction sake Mr. Le Blon calls those colours which are comprehended in the rays of the Sun, impalpable colours, and those used in painting, material colours. In the material colours, a mixture of all three produces a black or darkness, contrary to what is observed in the impalpable, which I said just now produce white. Mr. Le Blon takes this phaenomenon to be owing to the body or substance of which these three material colours consist, and their particles being opaque, for they only reflect certain rays of light that strike on their surfaces; and therefore when small particles of different colours are placed close together, if they are so small that each of them cannot be seen separately by the eye, we do not discern the colour of each particular atom, but only the blended reflected rays, proceeding from the adjoining particles: thus yellow and red produce an orange, yellow and blue a green, &c. which seems to be confirmed by placing two pieces of silk near together; viz. yellow and blue: when by intermixing their reflected rays, the yellow will appear of a light green, and the blue of a dark green; which deserves the farther consideration of the curious.

He hath reduced the harmony of colouring in painting to certain infallible Rules built on this foundation. Whereas, according to the common practice of painters, their colouring is the effect of meer chance or guess-work at first, but improved by experience; all painters usually declaring that there can be no certain rules given for mixing colours. Mr. Le Blon published, some years ago, an ingenious book on this subject, intituled, *Coloritto*; or the harmony of colouring in painting. By these rules he light on the manner of printing

ing any object in its natural colours, by the means of three plates, and the three primitive colours; an art attempted and sought after ever since the invention of printing, but in vain, and thought impossible, till he put it in practice about fifteen years ago. The plates are engraved chiefly after the mezzo tinto manner; only the darker shades, and sometimes the out-lines, where they are to appear very sharp, are done with a common graver. Each plate is not compleatly engraved, but only contrived to take such a portion of the colour as is necessary with the other two plates to make the picture compleat.

This art of printing consists in six articles; viz.

1. To produce any object with three colours and three plates.
2. To make the drawings on each of the three plates, so that they may exactly tally.
3. To engrave the three plates so as that they cannot fail to agree.
4. To engrave the three plates in an uncommon way, so as that they may produce 3000 and more good prints.
5. To find the three true primitive material colours, and to prepare them so as that they may be imprimable, durable, and beautiful.
6. To print the three plates so as that they may agree perfectly in the impression.

The first of which is the most considerable, comprehending the theoretical part of the invention; and the other five are subservient to bring it into mechanical practice, and of such importance, that if any one of them be wanting, nothing can be executed with success or exactness. Sometimes more than the three Plates may be employ'd; viz. when beauty, cheapness, and expedition require it.

The observation of the compounded colours reflected from two pieces of silk of different colours placed near together, first gave him the thought of what the effect of weaving threads of different colours would be, when all the threads were so fine, as not to be distinguished at a small distance one from another.

By the same principles of producing any visible object with a small number of colours, he arrived at the skill of producing in the loom all that the art of painting requires. An art likewise often attempted, but as often declared impossible till now, as well as the other of printing in colours. And 'tis probable, many improvements may from hence be made in several trades, especially in combing of wool, where the mixing of several colours may be of great use; but he hath not yet had time to apply it to any thing else besides painting, printing, and weaving.

The colours used in weaving being only superficial, and so differing from both the impalpable and the material colours, and not being to be so closely joined or incorporated together as those, will not of themselves produce a white or black, but only a light Cinnamon; wherefore, in weaving he hath been obliged to make use of white and black threads, besides red, yellow, and blue; and tho' he found he was able to imitate any picture with these five colours, yet for cheapness and expedition, and to add a brightness where it was required,

required, he found it more convenient to make use of several intermediate degrees of colours.

There are two ways in use at Brussels, and at the Goblins in Paris, for making tapestry after the common manner: one they call the flat way, and the other the upright. In the flat way they have the warp stretched in a frame length-wise of the piece: it is made of white worsted, and the pattern lies close under it; so that the workman can see the figures through the warp: he is provided with bobbins of various colours of silk or worsted, as the piece requires: then he takes up with his fingers one thread after another, as they answer to any colour in the painting beneath; and with the other hand passes the bobbin with the same colour, and strikes the threads close with an ivory comb. Some of these frames are made like a loom, with a warp passed through the leishes and treadles for the feet, with which they open the threads of the warp, to pass a common shuttle through them, when it is necessary to make a long throw, as is required in grounds, pillars, and tall uprights. In the upright way the warp runs from top to bottom of the piece; the pattern is placed upright, and close behind it, and the out-lines are drawn in charcoal upon the fore-side of the warp. The workman is placed with his back to the light, by which means he can see the pattern better; then he takes up the threads one by one, and passes the bobbin as in the other way, and strikes it close with the comb. All which is near as tedious as needle-work it self; which is the reason why fine tapestry comes to such high prices, so that none but princes care to buy it; and what can be had at a moderate price is always coarse, and of a low taste. For workmen who have any good notion of painting, and are capable of adjusting the colours are not to be had but for excessive wages; which much enhances the price likewise: but in Mr. Le Blon's new way of weaving tapestry in the loom with a draw-boy, tapestry may be performed almost as expeditious as fine brocades: for when the loom is once set and mounted, any common draft-weaver, tho' not acquainted with drawing nor painting; nay, hardly knowing what figure he is about, exactly produceth what the painter hath represented in the original pattern: and thus a piece of tapestry may be woven in a month or two, which in the common way of working would take up several years: and what in the common way costs a thousand pounds, may by this means be afforded finer and better for a hundred pounds. Therefore it is likely this woven tapestry may become a currant merchandize; and that many thousand industrious families may be well employed about it.

The main secret of this art consists in drawing the patterns, from which any common draft-weaver can mount the loom; and when that is done, the piece may be made of any size, by only widening the reeds and the warp; and a reverse may be made with the same ease; which is done by the boy's pulling the lashes up again in the same order in which he pull'd them down before; by which contrivance

the tapestry may be suited to any room, whether the light comes in on the right hand or on the left. The patterns are painted upon paper, whereon are printed squares from copper plates, and these subdivided by as many lines as answer to the threads of the warp, which run length-wise of the piece; then they try how many threads of the shoot answer in breadth to every subdivision of the squares. Every thread of the warp goes through a small brass ring called a male, or through a loop in the leish, and hath a small long weight or lingoe hung below, to counter-balance the packthreads, which going from the top of the rings or loops, are passed over the pullies in the table directly over the loom, and are continued nearly in a horizontal position on one side of the loom, to a convenient distance; where they are all spread on a cross-piece fastened to two staples: these are called the tail of the mounture; and from each of these packthreads, just by the side of the loom, are fastened other packthreads called simples, which descend to the ground; so that by pulling these simple chords, you raise any of the threads of the warp at pleasure; wherefore they fasten a loop or potlart to as many of these simple chords as there are threads of the warp to be pull'd up at every shoot, or every throw of the shuttle; by which means the shoot shews itself on the right side, where the warp is pulled up. And in ordering this, they are guided by the pattern, on which they count the distances of the subdivisions, which contain the same colours in the same line, and can be shot at once: then they fasten potlarts to the several simple chords that draw up the rings through which those threads of the warp run, which are to lie behind this colour; they tie all these loops together, and fasten a piece of worsted or silk to the knot, of the same colour that the workman is to throw; and the boy, when he pulls each loop, names the colour, that the weaver may take the proper shuttle, and so on for every colour to be thrown.

II. **T**HE making of tin-plates or latten, being not commonly practised in England, though there is so great a consumption of it, either because the method is not sufficiently known, or because that in use to make small quantities for particular purposes is much too dear to answer the artificer's expectation in making larger, whereby we are obliged to export our own tin to Germany, to receive it back again manufactured, I thought it not improper to lay before the society the method the Germans themselves make use of, as I have extracted it from a dissertation of Mr. De Reaumur, printed in the last volume of the memoirs of the academy of sciences of Paris, in which also he lays down some improvements, as he thinks, of his own.

The method of making tin-plates, extracted from the memoirs of the academy of sciences, for 1725. By Dr. W. Ruttie. n. 406. p. 630. Dec. 1728.

He takes notice then that the making of tin-plates, (which is called in France, white-iron) does not properly begin, till they go about to prepare the leaves or plates of iron that are to be tinned, which are supposed to be sufficiently thin and flat, and cut into squares: but

there are only certain sorts of iron which can be reduced into these leaves, of which those are the most proper, that when heated are easiest extendible, and yet can be forged with a hammer when cold; the more soft and extremely flexible, as well as the more brittle being to be rejected. These leaves are drawn from bars of iron about an inch square; which being made a little flat, they cut into thin pieces or soles (*semelles*) which they fold together, and having made them into parcels containing forty leaves each, beat them all at once with a hammer that weighs from 600 to 700 lb. weight. After this, the principal part of the whole art is to prepare these leaves; for the lightest dust, or the least rust upon their surface will prevent the tin from uniting with them. This may indeed be taken off by filing, but that being much too expensive, the same may be brought about by steeping the plates in acid waters for a certain time to what number they please, and when they are taken out, scouring them with sand, in order to fetch off any thing that may remain upon the surface: and by this method a woman may clean more plates in an hour, than the most expeditious workman can file in many days. Of these waters the author mentions several; but what the Germans themselves used, and which they make a mighty secret of, he found to be only common water made eager with rye, which requires very little pains. For after they have ground the grain grossly, and pounded it, they leave it to ferment in common water for a certain time, and with a little patience they are sure to have an eager menstruum. With this menstruum they fill troughs or runs, into which they put piles of iron plates; and to make it grow eager the better, and to have more activity, they keep these vessels in vaults or stoves which have little air, and in which they keep lighted charcoal. The workmen go into these vaults once or twice in a day, either to turn the plates that they may be equally exposed to the action of the acid liquor, or to take out those that are sufficiently cleansed, or to put others in their room: and as the liquor is more acid, or the heat of the vault or stove more intense, the plates are sooner cleansed; but it requires at least two days, and sometimes a great deal more. This is the method which the Germans employed in the tin-works in France, constantly made use of to prepare the iron-plates to receive the coat of tin: but as the author observed that the constant attendance upon them in the stoves was very laborious, the heat therein being almost insupportable to those who are not used to it, he proposes some other methods which are attended with very little trouble, and as small if not a less expence; and which upon trial succeeded full as well. Having therefore observed that the iron-leaves or plates are covered with a scale or layer half vitrified by the fire, on which acids have none or very little effect, he imagined that instead of dissolving the iron in these acid waters, it would be better to make it rust, and thereby put it in a condition to be easier cleansed from these scales;

as

as rust is accompanied with a sort of fermentation and rarefaction, and the matter which rusts takes up a greater space, and raises up whatever opposes it. To this purpose he steeped iron plates in different eager menstruums, as in water in which alum, common salt and sal-armoniack were separately dissolved; and others of the same iron he only dipped into the same waters, and instantly taking them out exposed them to the air. These latter were rusted by all of them, but sooner by that in which the sal-armoniack was dissolved. After two days, during which every plate had been dipped into the menstruum but twice or thrice, he scoured them, and likewise those he had left to steep for that time; and comparing them together, found that those, which had been only wetted at different times, cleansed better than those which were steeped; the rust covering all the surface of the latter without raising the scale; whereas in the former, as soon as one part of the metal is detached, it is attracted by the menstruum, and the surface is raised into blisters of rust. These dissolvents, the author takes notice, though weak in themselves, yet produce the effect as well as the stronger, which are much dearer: but amongst the latter he prefers vinegar, which being very plentiful in France, may be used with little cost. For you need only dip each leaf into it, and take it out again immediately, leaving it afterwards in some moist place, and it will be scaled in eight and forty hours, if you take care to repeat this three or four times in a day. The scaling will still be more expeditious, if you dissolve a little sal-armoniack in the vinegar, a pound or two to a puncheon; for as the vinegar dissolves iron well, so sal-armoniack, as just observed, rusts it sooner than any other salt: but this must be used very moderately, and the leaf must be left to steep in clean water to dissolve any particles of it that may stick to its surface; which may otherwise make it rust after it is tinned. If you scale with vinegar, and want to do it at a less expence, you need only plunge the leaves once or twice at farthest, and when the vinegar is dried upon the surface, sprinkle it with water; or dip them into it, and take them out immediately. There are several other ways of making iron rust, as keeping it in a moist cellar, exposing it to the dew, sprinkling it with simple water several times in a day, which will still act quicker by dissolving sal-armoniack in it. In those countries where the pyrites is common, the vitriolick waters will scale them soon enough, which are almost as cheap as common water: you need only heap the pyrites together, and leaving them to moulder in the air, make afterwards a lixivium with them and common water, which lie will have the desired effect. But as the leaves of iron are sensibly much easier cleansed on one side than the other, the bad side rarely taking the brilliant polish in the tinning, but having always some spots, which proceeds from this, that in the beating, one side is more exposed to the action of the hammer, and is therefore better plained, the author again advises not to steep them,

but only to moisten them, in order to make them rust, whereby you need moisten that side only that wants it most. Whereas if you steep them, as the bad side will take double or triple the time of the other, the acid menstruum will dissolve the surface, and occasion a loss of iron. He next gives two cautions necessary to be followed: the first is in the management of the plates before they come to be prepared; which is in the heating of them, to change the place of each in its turn, that every one may receive the immediate action of the hammer, otherwise they will not extend equally: the second is to steep them in clay or fuller's earth tempered with water before you heat them, to prevent their soldering with one another. He then closes this part of the operation with remarking that whatsoever of these methods are pitched upon, whether the old one, of which he has learnt the secret, or any of the new, which he has here shewn, it is absolutely necessary after the plates are sufficiently scaled, to scour them with sand, and when there remains no more black spots upon their surface, to throw them into water to prevent their rusting again, and leave them in it till the instant you would tin them, or in the term of art, blanch them. This he observes is the very object of the whole art, and is kept as much a secret by the blancher, as the acid eroding menstruum is by the scaler: but the manner of doing it is thus. They flux the tin in a large iron crucible, which has the figure of a broken pyramid with four faces, of which the two opposite ones are less than the two others. This crucible they heat only from below, its upper border being luted in the furnace quite round. The crucible is always deeper than the plates which are to be tinned are long, which they constantly put in downright, and the tin ought to swim over them. For this purpose artificers of different trades prepare the plates in different manners, which are all exceptionable. But the Germans he perceived made use of no preparation whatsoever, except putting the scoured plates into clean water, as just remarked; but when the tin is melted in the crucible, they cover it with a layer of a sort of suet, an inch or two thick, through which the plate must pass before it comes to the tin: the first use of which is to keep the tin from burning, and if any part should take fire, as the suet will soon moisten it, to reduce it to its natural state again. This suet is compounded, as the blanchers say, and is of a black colour, which the author thought might be given it with soot or the smoak of a chimney, only to spread a mystery over their work; but he found it true so far, that common unprepared suet was not sufficient: for after several attempts, there was always something wanting to render the success of the operation certain. The whole secret then of blanching lies entirely in the preparation of this suet: and this he at last discovered to consist only in first frying and burning it; which not only gives it the colour, but puts it into a condition to give the iron a disposition to be tinned, which it does surprisingly. The tin itself ought

ought to have a certain degree of heat ; for if it is not hot enough it will not stick to the iron ; if it is too hot, it will cover it with too thin a coat, and the plates will have several colours, as a mixture of red, blue, and yellow, and the whole appear of a villainous yellow cast. To prevent this, by knowing when the tin has a proper degree of heat, they might first make an essay with small pieces of the scaled plates, and they would learn from them when the tin is in proper order : but generally speaking, they dip the plates into tin that is more or less hot, according to the thickness they would have the coat to be of. To some plates they only give one layer, and these they plunge into tin which has a less degree of heat than that into which they plunge those plates which they would have take two layers ; as also when they give these the second layer, they put them into tin that has not so great a degree of heat, as that into which they were put the first time : besides, it is to be observed, that the tin, which is to give the second coat, ought to be fresh covered with suet, but only with the common sort without preparation ; for melted tin is sufficiently disposed to attach itself to solid tin ; and in this case it is to tin itself, to which the new tin is to be joined. As to the choice of the tin, the manner of making it is as bright as possible, with a number of little articles necessary to the practice, the author refers them to another time, as more properly belonging to the description of the whole art, than to a memoir in which he only gives the principles of it.

III. **F**inding the accounts which we have of the French weights different in different books, I sent to a curious gentleman for some Paris weights exact to the standard weights at the Chatelet ; and found upon tryal the Paris ounce which contains 576 of their grains, to be equal to 476 of our grains troy ; from which experiment all the other proportions may be deduc'd.

Paris and English weights compared. By Dr. J. T. Desaguliers. n. 366. p. 112. Sept. &c. 1720.

The French Pound cont. 16 ounces.

Ounce — 8 drams, or 576 Paris grains.

Dram — 3 deniers.

Denier — 24 grains.

IV. **M**R. de Lisle in the account of his method of making an exact plan of Paris, and comparing it with London, and other cities, first shews by what means he proceeded in determining the true situation of the several places in Paris : after which he explains his manner of drawing a true meridian line through that city ; whereby he was enabled to divide it by meridians and parallels, as is practis'd in a general map : and then goes on in the following words : “ I traced the parallels from 15 to 15 seconds, and the meridians from 20 to 20. And, as under the parallel of Paris, 15 degrees of latitude are equivalent to 20 of longitude, and the like is true of minutes and seconds ; by allowing 5 seconds more to the intervals of the meridians, than to those of the parallels, I form'd perfect squares.”

Reflections on Mr. de Lisle's comparison of the magnitude of Paris with London and several other cities. By Peter Davall, Esq; n. 402. p. 432. Ap. &c. 1723.

He

He says, the chief use he intended to make of these squares, was to compare the magnitude of Paris with that of London, and gives an account of what method he took to procure a just plan of this city, which he reduced to the same scale as that of Paris, and proceeds thus: "I traced upon it in like manner, squares from 15 to 15 seconds of a great circle, and then I was prepared to compare the greatness of the two cities." "The result of this comparison is, that Paris contains 63 of these squares, which makes for its superficies 3538647 square toises: and that London contains only 60 of those squares, or 3370140 square toises." And from hence he concludes that Paris is one twentieth part greater than London, tho' he says he has excluded several gardens contained within Paris out of this mensuration, which would have made it bear still a greater proportion to London.

Upon reading this account of Mr. de Lisle's, it immediately occurred to me, that the method which he has here taken of comparing the magnitudes of Paris and London, from whence he infers that the first of these cities is one twentieth greater than the later, is founded on a false supposition, viz. that under the parallel of Paris 20 degrees of longitude are equal to 15 of latitude, and consequently that by drawing meridians from 20 to 20 seconds, and parallels from 15 to 15, the figures formed by their intersection will be perfect squares. For the equator and its parallels are to each other as the sines of their respective distances from the pole. Whence, as the radius, or sine of 90 degrees, is to the sine of the distance of any parallel from the pole, or coline of its latitude:: so is a degree or any other part of the equator, or of any great circle, to the like part of the given parallel. Therefore taking the mean latitude of Paris at 48°. 51', the proportion of the degrees of a great circle to those of the parallel of Paris will by a table of sines be found to be as 1 to .6580326. Whereas according to Mr. de Lisle, that proportion is only as 20 to 15, or as 1 to .75. The figures therefore which Mr. de Lisle calls squares, are not such, but rectangles, whose longest side containing 15 seconds of a great circle, bears the same proportion to the shortest, containing 20 seconds of the parallel of Paris, as .75 does to .658, &c. or nearly as 8 to 7. And the intervals which he ought to have allowed to the meridians to make perfect squares of these figures, ought to have been $\frac{15}{658}$ &c. seconds, or nearly 22" $\frac{4}{5}$ or 22". 48" of the parallel of Paris.

Now Mr. de Lisle says, these figures are perfect squares, and has computed them as squares, whose side was 15" of a great circle; for he says Paris contains 63 of these squares, which makes 3538647 square toises, which last number being divided by 63, the quote 56169 will be the number of square toises contained in each square, whose square root gives 237 toises for the side of each square, which is just 15" or $\frac{1}{240}$ of a degree of a great circle. Mr. de Lisle hath therefore by this account made the superficial content of each rectangle, and consequently

consequently of the whole city of Paris too great by near one seventh. To confirm which beyond contradiction we have Mr. de Lisle's own testimony, who in the plan he himself has drawn and published of Paris, and to which he refers in this very account, has not made squares of the above-mentioned figures, but has given to their respective sides the proportion of 8 to 7, which is as near the true one as can well be express'd by lines, in a plan of no larger a scale than this.

Now in the account we have been considering, Mr. de Lisle says himself, that in measuring London he drew squares whoses sides contained 15 seconds of a great circle, and of these he says, London contains sixty. Therefore to compare Paris with London, we ought for the foregoing reasons to make an abatement out of the 63 rectangles which Paris contains, nearly in the proportion of 8 to 7; but because that is a little greater than the true one, let us make such a-batement only in the proportion of 9 to 8, which is pretty considerably less than the just one. By which abatement the number of squares, whose side is 15 seconds of a great circle contained in Paris, will be reduced from 63 to 56. And consequently, according to Mr. de Lisle's own way of measuring, the magnitude of London will be to that of Paris as 60 to 56, or as 15 to 14; or London will be one fourteenth greater than Paris. But to determine what proportion these two cities really bear to each other, requires a more exact mensuration of London than any we yet have, which whoever would undertake, I think he cannot follow a better method than that Mr. de Lisle has taken, and would advise him to consult the account upon which the foregoing reflections are made, which he may find in the *Memoirs of the R. Academy of Sciences*, for 1725. p. 48.

V. **I**N the kingdom of Norway on the confines of Sweden, live a sort of people call'd Finns, whose habitation is in the woods and forests, and who are some of them under the Danish, some under the Swedish jurisdiction, of whose original, nature, and manner of life, I shall give some account.

I. Their original was from Swedish Finland eastward of the sea of Bothnia, from whence by hunger, and want of the necessaries of life, they transported themselves into Sweden and Norway, where in the forests and wildernesses they got leave to build and inhabit. For the common people of Finland are strong and hardy, and by consequence fruitful and long-liv'd. Finland formerly was not so well cultivated as at present it is; so that the produce of the earth was not sufficient to subsist the numbers of people born there; insomuch that abundance of them (as the Goths and Vandals) were obliged to seek out new quarters: and tho' these people have for the most part kept their native language, yet have they made several alterations in their manners and ways of living. As to their language, (tho' the much greater

An account of the Norwegian Finns or Finlanders. By Peter Kinck Esq; to J. Theobald Esq; n. 400. p. 357. O.B. &c. 1727.

greater part of them both understand and speak the Norwegian tongue, as well as the Swedish) yet they mostly use their own, which has not the least affinity to or resemblance of either the other two. For example, where the Swedes and Danes, in numbering tell 1, 2, 3, een, toe, tree, they in theirs tell yx, kax, kolime, and as the first say, for give me bread, "giv. mig brod," they say "Alla mina leip, &c." And when we stand and hear them converse together, we are surpriz'd to conceive how they understand each other, since they speak so very low, that we can scarce hear them.

2. Of their nature. They are generally low of stature, but strong, hardy, and healthy; their eyes are lively, their noses high, their teeth even and white, and their feet short. The women are generally so strong of constitution, that in child-bearing they seldom need any assistance, and soon return to the business of the family again, except here and there a weakly constitution. They are generally ignorant and silly; but this must be attributed to the little converse they have with each other and the rest of the world, since the men, whose affairs call them often to traffick with their neighbours and in different provinces, have good natural parts, all sharp, and look well to their interest. They are frugal, parsimonious and humble, fearful of giving offence, and very respectful to their superiors. They will work whole days without any food, if they can only have tobacco to smook or chew.

3. Of their manner of life. Their food consists chiefly in a sort of fish which they call Oret, and which answers to our salmon-trout; ('tis a very delicious fat fish, which they catch in the rivers that run thro' the woods) and next to that, in bread and flower of rye, of which they sometimes get great plenty, by cutting down and burning whole forests, and sowing the ground with rye, which sometimes produces thirty or forty fold. But this method of producing has been of late very strictly forbidden, under most severe penalties, by the landlords of those forests, because of the immense damage it does, by the loss of so much timber; and because the fire sometimes lays waste immense tracts of land: so that it is with great difficulty extinguish'd, burning whole months together, to the great detriment of trade.

They frequently use bathing, at least once a month, thinking thereby they prevent sickness, and dissipate all weaknesses from the body: and their method of bathing seems so very particular, as would scarce agree with any other constitution, or meet with approbation from physicians. They bath thus: in the middle of the house (which generally consists of one large room, built all of whole timbers laid cross, and notch'd in at the ends to let them close, and then caulk'd with moss, as the seams of a ship are with okham) they build an oven with stone without mortar, and without a funnel; the smook going out at a hole in the roof, which is left open while the wood

wood is burning in the oven, but shut close as soon as it is burnt to a bright coal, which keeps in all the heat. When the oven is thus made red hot, they then strip, both men and women, without any reserve, and place themselves on benches made near the roof on purpose: then cold water is brought in, which from time to time is sprinkled upon the oven; from whence arises a thick steam on the bathers, which makes their bodies so warm, that they sweat very plentifully. They have all rods in their hands with which they gently beat their bodies; and if they find themselves so hot that they cannot well endure it, they call for cold water, which they pour over themselves in so dextrous a manner, that it diffuses it self over their whole bodies, and so cools them again. Thus when they have bathed sufficiently, they go directly out into the air, tho' in the most inclement season of the year; and what is more, will roll themselves in the snow for a good while together, and get no harm by so doing; and this method of bathing they make use of as their ordinary cure, when they find any indisposition of body upon them.

In the winter, when the ground is cover'd with snow, they make use of a sort of long wooden shoe, "*Inducunt soleas ligneas tres vel quatuor ulnas longas,*" on which they go so swiftly, that in two hours time they will run thirteen or fourteen miles: and as they are generally good marks-men, with their guns they kill abundance of wild game, both to support their families, and to sell for buying themselves necessities.

They are very ignorant of christianity, by reason of their great distance from any towns; but that misfortune the present king of Denmark has taken some measures to remedy: yet tho' they seem so ignorant and barbarous, 'tis very rare that any of them are guilty of considerable crimes.

VI. 1. **T**HE hunter in a clear sun-shiny day takes a plate or trencher with a little sugar, honey or molosses spread on it, and when got into the woods, sets it down on a rock or stump there; this the bees soon find out; for 'tis generally supposed a bee will scent honey or wax above a mile's distance; and it is observed when one bee goes home from the sugar-plate, he returns with a considerable number from the hive. The hunter secures in a box or other conveyiency some of them as they fill themselves, and after a little time lets one of them go, observing very carefully the course it steers; for after he rises in the air, he always flies directly to the tree where the hive is. Then by the help of a pocket compass, and other implements, the hunter sets down the course, suppose it west; by this he is sure the tree must be somewhere in a west line from where he is, but wants to know the exact distance from his station; and to determine that he makes an off-set either south or north, suppose north, one hundred perch or rod, (if it be more, it will still be more

To discover where the bees hive in the woods in New England, in order to get their honey. By Paul Dudley Esq; in 367. p. 148. Jan. 1721.

42 *Bees first carried from England to N. England. PART IV.*

exact, because the angle will not be so acute, then he takes out another bee and lets him go, observing his course also very carefully, for he being loaded will, as the first, (after he is mounted a convenient height) fly directly to the hive; this second course, as I must call it, the hunter finds to be south, 54 degrees west; then there remains nothing but to find out where the two courses intersect, or the distance from B to A, or from C to A, as in figure 7. for there the honey tree is. For which reason if the course of the second bee from C had been south-west and by south, viz. to D, then the hive tree must have been there, for there the lines are found to intersect.

Fig. 7.

The race of bees now in New England first carried there from England. By the same.
n. 367. p. 150.
Jan. &c. 1721.

VI. 2. **A**LL the bees we have in our gardens or woods, and which now are in great numbers, are the produce of such as were brought in hives from England near a hundred years ago, and not the natural produce of this part of America; for the first planters of New England never observed a bee in the woods, until many years after the country was settled; but that which proves it beyond question is, that the Aborigines have no word in their language for a bee, as they have for all animals whatsoever proper to, or aboriginally of the country, and therefore for many years called a bee by the name of Englishman's fly.

N. B. When bees swarm they never go northward, but southward or inclining that way.

Some observations made by a young gentleman who was born blind. By Mr. W. Cheselden,
n. 402. p. 447.
Apr. &c. 1728.

VII. 1. **T**HOUGH we say of the gentleman that he was blind, as we do of all people who have ripe cataracts, yet they are never so blind from that cause, but that they can discern day from night; and for the most part in a strong light, distinguish black, white, and scarlet; but they cannot perceive the shape of any thing; for the light by which these perceptions are made, being let in obliquely thro' the aqueous humour, or the anterior surface of the crystalline (by which the rays cannot be brought into a focus upon the retina) they can discern in no other manner, than a sound eye can thro' a glass of broken jelly, where a great variety of surfaces so differently refract the light, that the several distinct pencils of rays cannot be collected by the eye into their proper foci; wherefore the shape of an object in such a case cannot be at all discerned, tho' the colour may: and thus it was with this young gentleman, who tho' he knew these colours asunder in a good light; yet when he saw them after he was couch'd, the faint ideas he had of them before were not sufficient for him to know them by afterwards; and therefore he did not think them the same, which he had before known by those names. Now scarlet he thought the most beautiful of all colours, and of others the most gay were the most pleasing, whereas the first time he saw black it gave him great uneasiness, yet after a little time he was reconciled to it; but some months after seeing by accident a negroe woman he was struck with great horror at the sight.

When he first saw, he was so far from making any judgment about distances,

distances, that he thought all objects whatever touch'd his eyes, (as he express'd it) as what he felt, did his skin; and thought no objects so agreeable as those which were smooth and regular, tho' he could form no judgment of their shape, or guess what it was in any object that was pleasing to him: he knew not the shape of any thing, nor any one thing from another, however different in shape or magnitude; but upon being told what things were, whose form he before knew from feeling, he would carefully observe, that he might know them again; but having too many objects to learn at once, he forgot many of them; and (as he said) at first he learn'd to know, and again forgot a thousand things in a day. One particular only (tho' it may appear trifling) I will relate; having often forgot which was the cat, and which the dog, he was ashamed to ask; but catching the cat (which he knew by feeling) he was observ'd to look at her steadfastly, and then setting her down, said, so puss! I shall know you another time. He was very much surpriz'd, that those things which he had lik'd best, did not appear most agreeable to his eyes, expecting those persons would appear most beautiful that he lov'd most, and such things to be most agreeable to his sight that were so to his taste. We thought he soon knew what pictures represented, which were shew'd to him, but we found afterwards we were mistaken; for about two months after he was couch'd, he discovered at once, they represented solid bodies; when to that time he consider'd them only as party-colour'd planes, or surfaces diversified with variety of paint; but even then he was no less surprized, expecting the pictures would feel like the things they represented, and was amazed when he found those parts, which by their light and shadow appear'd now round and uneven, felt only flat like the rest; and asked which was the lying sense, feeling, or seeing? Being shewn his father's picture in a locket at his mother's watch, and told what it was, he acknowledged a likeness, but was vastly surpriz'd; asking, how it could be, that a large face could be express'd in so little room, saying, it should have seem'd as impossible to him, as to put a bushel of any thing into a pint.

At first he could bear but very little sight, and the things he saw, he thought extremely large; but upon seeing things larger, those first seen he conceived less, never being able to imagine any lines beyond the bounds he saw; the room he was in he said, he knew to be but part of the house, yet he could not conceive that the whole house could look bigger. Before he was couch'd, he expected little advantage from seeing, worth undergoing an operation for, except reading and writing; for he said, he thought he could have no more pleasure in walking abroad than he had in the garden, which he could do safely and readily. And even blindness he observ'd, had this advantage, that he could go any where in the dark much better than those who can see; and after he had seen, he did not soon lose this quality, nor desire a light to go about the house in the night. He

said, every new object was a new delight, and the pleasure was so great that he wanted ways to express it; but his gratitude to his operator he could not conceal; never seeing him for some time without tears of joy in his eyes, and other marks of affection: and if he did not happen to come at any time when he was expected, he would be so griev'd, that he could not forbear crying at his disappointment. A year after first seeing, being carried upon Epsom downs, and observing a large prospect, he was exceedingly delighted with it, and call'd it a new kind of seeing. And now being lately couch'd of his other eye, he says, that objects at first appear'd large to this eye, but not so large as they did at first to the other; and looking upon the same object with both eyes, he thought it look'd about twice as large as with the first couch'd eye only, but not double, that we can any ways discover.

Of the instruments used in a new operation on the eyes. By the same. n. 402. p. 451. Apr. & C. 1728. Fig. 8.

VII. 2. **A B** represent the figures of two eyes, on which a new operation was perform'd by making an incision thro' the Iris, which had contracted it self in both cases so close, as to leave no pupil open for the admission of light. The perforation in the eye A was made a little above the pupil, the closing of which ensued upon the putting down a cataract, which not knowing how low it might be lodged, I made the incision a little higher than the middle, lest any part of it should lie in the way. The eye B was one I couch'd not long before, where the patient had been blind but a few years. At first he thought every object further or higher from him than it was; but he soon learn'd to judge the true distance, the cause of which I shall endeavour to explain by figure 9. in which let the circle **H I K** represent the eye, **H** the place where an image through the natural pupil **I** was represented from the place **M**; now the artificial pupil being at the place **K**, the object at **L** is now painted at the place **H**, where the object **M** was also to be perceiv'd; therefore it was, I suppose; that the patient mistook the place **L** for the place **M**; or the place **N** for the place **O**.

Fig. 9.

Fig. 10.

C is a sort of needle with an edge on one side, which being pass'd thro' the Tunica Sclerotis, is then brought forwards thro' the iris a little farther than **E**. This done, I turn the edge of the needle, and cut thro' the iris as I draw it out: the handle of this needle is half black and half white, which though it is not of so much use in this operation, is very much so in couching needles, we being thereby able to judge of their position, when we do not see them.

Fig. 11.

F F is an instrument to keep open the eye-lids. **G** is a bit of iron, which as it is moved backward or forward the instrument opens and closes.

Of a boy in Scotland that lived very long without food.

By Dr. P. Blair, 1716, and toward the end of the said month was seized with a violent fever, in which he continued three weeks, and then recover'd.

VIII. **G**ilbert Jackson about fifteen years of age fell sick, and complained of pains over all his body on the 3d of Feb. 1716, and toward the end of the said month was seized with a violent fever, in which he continued three weeks, and then recover'd.

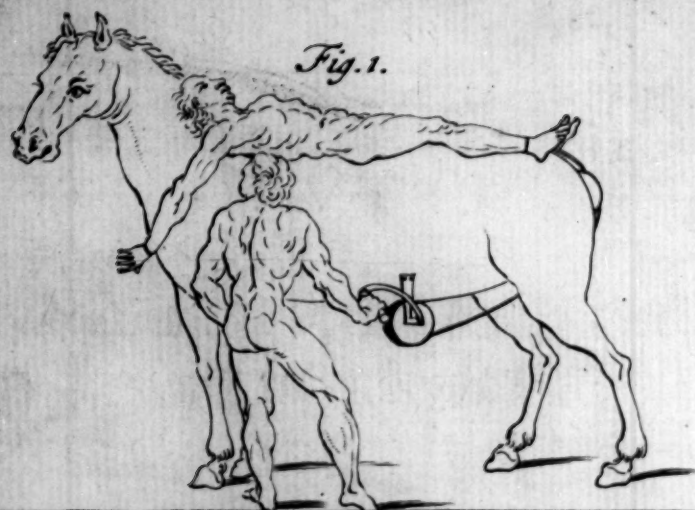


Fig. 1.

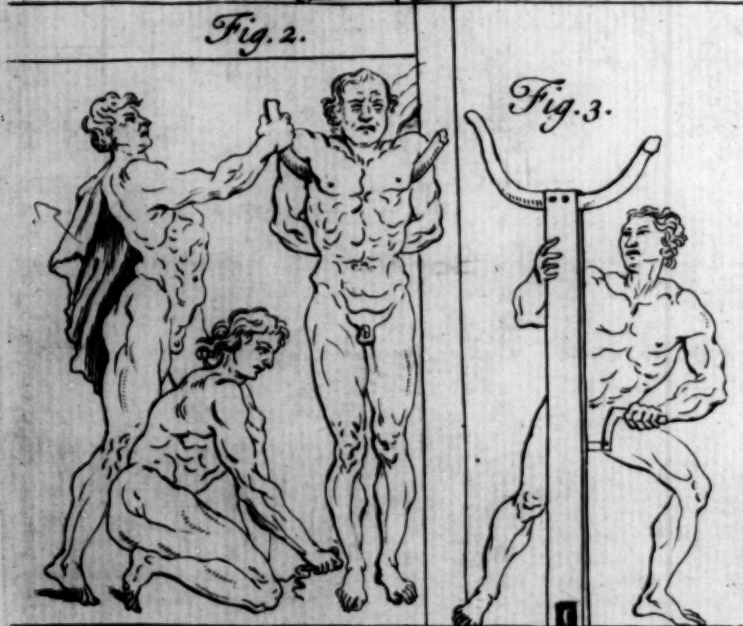
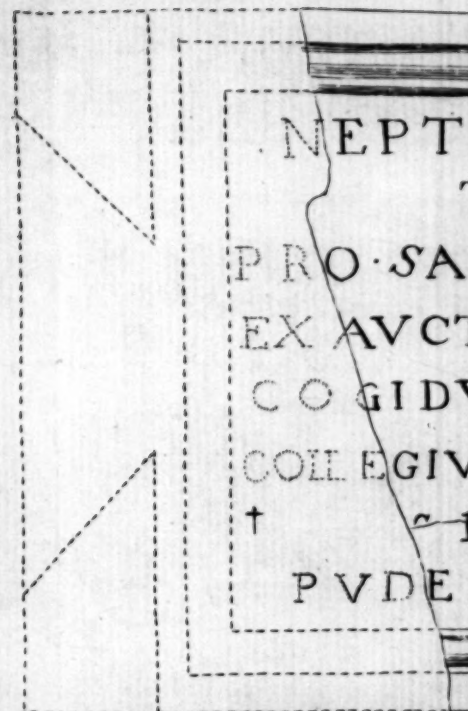


Fig. 2.

Fig. 3.



† A. SACRS
or
HONOR.S.



Fig 8



Fig. 10.



Fig. 9.

Fig. 4.



Fig. 6.

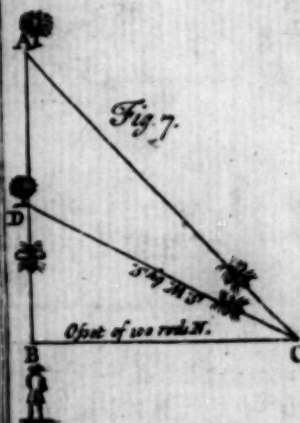
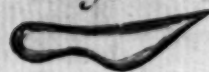


Fig. 5.



Scale of Roman feet

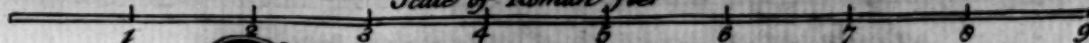
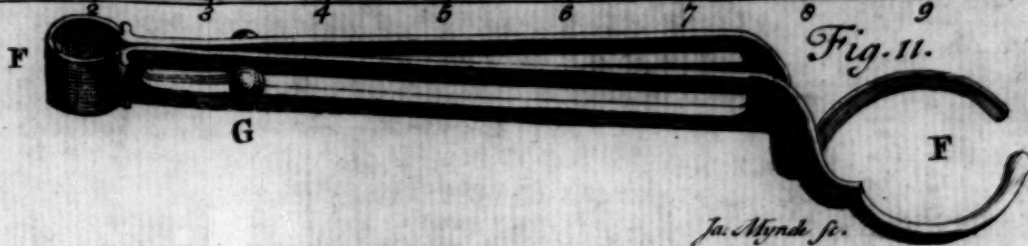


Fig. 11.



Ja. Mynde sc.

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 M
 I

He fell in a fever again the beginning of April thereafter, wherein he also continued for the space of three weeks, during which he had a shaking in his body, as if he had been paralytick. Upon the 10th of June following he fell in a great fever again, when he became dumb, lost his stomach intirely and the use of his limbs, and continued without eating or drinking any thing, tho' all means were used to make him do both; he recovered of his fever upon the 17th of May, 1717. but continued still dumb without eating or drinking, or having the use of his limbs, till the 10th of June the said year, when he was again seized with an extraordinary fever, and the next day recovered his speech; but continued in the fever without eating or drinking any thing at all, or having the use of any of his limbs, till the 11th of November following; when he recovered his health pretty well, and the strength of one of his legs. And thus he continued without eating or drinking, only washed his mouth sometimes with water; and always, when he saw the rest of the family going to take any kind of food, the sight of it being altogether uneasy to him, he retired.

Upon the 10th of June 1718, he fell in a fever again; which continued till the beginning of September thereafter, when he recovered of it, tho' he never could be induced to take any kind of meat or drink; and thus he continued in pretty good health, and fresh coloured, till the 9th of June 1719, when he was again seized with a severe fever; and upon the 10th at night, his father pressed him extremely to take a little milk boiled with oat-meal, which at length he agreed to; and he took a spoonful of it, which stuck so long in his throat, that his parents thought he had been choaked; and ever since he has taken some food, but so very little, that a halfpenny loaf serves him eight days. All the time he fasted, he never had any evacuation either by stool or urine; and it was fourteen or fifteen days after he began to eat, that he got any benefit that way. He is now in pretty good health, but still wants the use of one of his limbs.

IX. **A**T Uttoxeter in the moorlands of Staffordshire in 1702, were buried at the following ages, three women in fourteen days; the first 103, the second 126, and the third 87; in the same year two sisters and a brother in and of that parish, the brother 92, the youngest sister 95, the eldest 98.

Examples of long life. By Dr. Simon Degg. n. 400. p. 364. Oct. 1727.

And in the same parish this present year 1726, were buried in 22 days the following aged people.

August 7. one woman aged 94, and one man aged 81.

August 4. one man, aged

August 19. one man, aged

August 22. one man, aged

August 23. one man, aged

68

87

82

83

Men 4

Women 2

In

The bills of mortality, &c. of several considerable towns in Europe beginning from Christmas 1716. to Christmas 1717. Extracted from the Acta Breslaviensia. By Dr. C. J. Sprengell, n. 380. p. 454. Nov. &c. 1723.

In 1726. at Gravely in Hertfordshire 31 miles from London, almost every sixth soul is upwards of sixty. Inhabitants 187, aged above sixty 29.
X. 1. **T**HE usefulness of these registers is now so well known to the learned world, from the labours of many curious and inquisitive persons in political arithmetic, that we conceive the following will need no recommendation to render them acceptable to the public.

BRESLAW in SILESIA.

Buried.		Christened.	
In January	91	Males	584
February	113	Females	576
March	136		
April	108		1160
May	127	Among the buried were	
June	144	Married men	226
July	144	Married women	144
August	208	Widows and widowers	157
September	128	Batchelors	60
October	96	Maidens	57
November	113	Boys	} under ten years old
December only till the		and Girls	
24th	77	Stillborn	} boys girls
	1485		

N. B. Here in the sum total are 29 more than in the number of the buried above, by reason of several stillborn children which had no regular burial, and so were not reckoned.

In the imperial town VIENNA, there died,

Young people ————— 3179
Old ————— 2026

Total 5205

Among which were,

Of 90 years old		Of 99	
91	1	100	1
92	3	102	2
93	1	103	1
94	3	104	1
95	2	115	1
96	3		

Born and christened ————— 4030 children.
In DRESDEN, Saxony, died ————— 1908
Christen'd ————— 1443
In DANTSZICK died ————— 1605
Christened ————— 2102

Hungary, died _____ 132

Christen'd _____ 157

Most of these died of the small-pox.

The bills of mortality from Christmas 1717 to Christmas 1718.

BRESLAW.

Buried.		Christened.		
From the 25th of Dec. to the 31st	21	Males	598	
January	129	Females	554	
February	112		1152	
March	108			
April	98	Among the dead were		
May	88	Married men	238	
June	97	Married women	141	
July	86	Widows and widowers	122	
August	118	Batchelors	60	
September	98	Virgins	60	
October	119	Children to ten } boys	282	
November	100	years of age } girls	280	
December till the 24th	81	Stillborn { boys	47	
			{ girls	25
Total	1255			

In VIENNA died Men	1432	Women	1129
Boys	1844	Girls	1705
In all	6110.		

Amongst which were froze to death in the street	2	By taking wrong physick	1
Murder'd	2	Trod to death by horses	4
Kill'd by a waggon	2	Drown'd	5
By falls from houses, &c.	11	Beat to death	1
Kill'd with swords, knives and fabres	9	Smother'd in a house of office	4
		Cut their throats	2
		Kill'd by the fall of houses	5

Among the dead were found		Christened.	
8 persons of 90 years old.		Males	2185
7 92		Females	2057
2 93			
3 94			Total 4242
3 95			
1 96			
2 97			
2 98			
2 99			
1 100			

Amongst which were 48 pair of twins, and once Tergemini.

In RATISBON died of the Lutherans, 235 persons; amongst which were 117 children, 13 young men, and 11 young women. An

Bills of Mortality, &c.

PART IV.

An account of the christnings, burials, marriages, &c. of several cities in SAXONY.

	<i>Christened.</i>	<i>Baptists.</i>	<i>Buried.</i>	<i>Pair married.</i>	<i>Communicants.</i>
In Dresden	1578	99	1412	501	78875
Wittemberg	286	16	317	61	13536
Leipzig	861	68	953	303	
Torgau	136	9	148	54	7917
Freyberg	340	13	373	104	24098
Stollberg	88		112	27	7314
Pulsnitz	73		75	39	4381
Königsbruck	67		95	16	3351
Elstra	63		45	11	3021
Bautzen	207	5	135	55	14520
Annaberg	146	19	112	37	8426
Chemnitz	173	4	166	38	10690
Oschatz	103	3	82	20	5169
Altenburg	141		248	57	12901
Eulenberg	96	5	86	41	6194
Pirna	138	2	133	43	9164
Marienberg	91		194	18	5903
Georgenstadt	182		191	36	3580
Harta near Waldheim	40	3	29	20	3291

A List of the number of people, married, christened, buried, and communicants, from 1617 to 1717, both inclusive, in the Electoral City of FREYBERG, near the Molde in Saxony. Lat. 51. Long. 32, 43. about 8 miles S. W. from Dresden.

No. Years.	Pair marr.	Cbrif- tened.	Baf- tards	Buried.	Communi- cants.	No. Years.	Pair marr.	Cbrif- tened.	Baf- tards	Buried.	Communi- cants.
1617	89	539	4	430	10530	1638	53	262	9	151	7682
18	122	423	10	384	9031	39	45	292	4	354	9609
19	124	495	13	371	9789	40	65	268	6	173	7594
20	97	428	10	451	10093	1641	61	226	2	163	7562
21	106	430	6	507	9676	42	48	309	4	193	8128
22	110	380	7	517	9536	43	60	383	7	340	7770
23	100	357	8	589	9206	44	65	231	7	156	7699
24	96	383	4	417	9509	45	62	196	5	163	7050
25	98	375	7	454	10058	46	57	230	6	187	7263
26	78	381	6	549	11642	47	59	201	2	136	7173
27	108	372	7	331	11027	48	59	197	1	182	7698
28	82	371	4	318	10745	49	44	222	5	201	7739
29	87	412	19	536	11531	50	65	199	1	162	7639
30	80	330	7	1114	11180	1651	65	232	1	168	8148
1631	135	353	4	284	10524	52	50	190	2	202	7948
32	88	425	5	1343	11326	53	62	208	2	215	8342
33	174	163	4	879	9131	54	62	234	3	211	8648
34	170	375	1	175	7447	55	73	202	1	194	6351
35	87	285	9	231	7323	56	60	237	5	151	8493
36	61	299	11	181	7590	57	58	230		174	8730
37	68	386	3	383	7723						1658

No. Years.	Pair marr.	Chrif-tened.	Bap-tards	Buried.	Communi-cants.	No. Years.	Pair marr.	Chrif-tened.	Bap-tards	Buried.	Communi-cants.
1658	61	198	4	184	8561	1689	59	275	4	301	11393
59	57	251	3	177	8431	90	72	290	5	310	11185
60	66	230		240	8856						
1661	47	225	3	217	8962	1691	72	269	6	289	11724
62	53	203	2	206	9423	92	58	284	7	296	12679
63	47	206	2	247	9264	93	72	316	10	253	11597
64	48	219	2	179	9279	94	65	236	7	355	12533
65	61	213		207	9406	95	57	239	6	339	13196
66	65	218	4	216	9979	96	85	277	10	290	14900
67	79	223		306	9448	97	76	216	4	180	15619
68	63	228	5	232	9588	98	73	274	7	218	15677
69	55	232		204	9572	99	64	264	5	258	16155
70	70	218	4	206	9564	1700	74	251	7	310	18569
1671	65	237	3	291	10080	1701	81	283	10	188	19282
72	64	207	2	286	9221	2	88	272	2	239	20383
73	69	234	1	215	9912	3	95	271	6	241	20494
74	55	228		204	9678	4	88	319	11	273	20837
75	60	233	1	246	10093	5	72	295	12	357	20743
76	58	226	1	277	9956	6	85	332	10	245	21813
77	80	240	3	296	10462	7	82	310	18	378	21367
78	70	256	4	302	10422	8	83	310	17	288	21838
79	91	225	4	254	10356	9	71	302	10	305	21708
80	63	292	4	267	11349	10	83	313	15	283	21699
1681	87	285	5	218	11043	1711	81	327	8	311	22334
82	69	282	7	253	10894	12	82	310	9	325	22837
83	77	315	8	333	11054	13	87	308	9	340	23627
84	78	334	6	314	10623	14	70	349	6	237	23470
85	73	249	4	251	11070	15	82	323	8	283	23273
86	73	282	5	243	11488	16	105	317	14	361	23371
87	80	327	6	292	11542	17	79	373	13	325	23904
88	88	308	11	234	11300	Total 7546 28841 582 30295 1211761					

Here is to be observed, that in the years 1625, 26, 27, 32, and 33, the plague raged very much; as also, that in the year 1630, there died of the plague meerly 764, and in 1680, 103. Besides that, amongst the christened in 1713, a girl was baptized, which was born and bred in Turkey, but from christian parents.

But in general it may be observed, that this place was more populous before the war than it is at present; tho' in this century it cannot but very much recover and increase.

The following list we have received from Berlin, consisting of all that were born, married and buried in PRUSSIA, in four years.

	Years.	Born.	Pair married.	Buried.
In the Kingdom of PRUSSIA.	1715	19606	4571	12000
	16	20669	4530	12155
	17	21443	4743	12301
	18	20994	4287	11047

Sum 82712 18131 47503
G The

The next list contains the number of all that were born, married and buried, in the rest of the king of PRUSSIA's dominions in Germany, &c. for four years.

	<i>Years.</i>	<i>Born.</i>	<i>Pair married.</i>	<i>Buried.</i>
In the Electorate of BRANDENBURG.	1715	14820	4368	11663
	16	15758	4995	13149
	17	16636	4539	10805
	18	17319	4657	12891
	Sum	64533	18559	48508
In the NEW- MARCK.	1715	5487	1683	4757
	16	4973	2010	4502
	17	7052	1850	4673
	18	6684	1882	5069
	Sum	24396	7425	19001
In the Dutchy of MAGDEBURG.	1715	7185	2064	4982
	16	7225	2186	5602
	17	8746	2306	6291
	18	8325	1934	5744
	Sum	31481	8490	22619
The Dutchy of CLEVE.	1715	6772	1964	5066
	16	7313	2001	6221
	17	7582	2051	6055
	18	7542	1891	5865
	Sum	29209	7907	23207
The Dutchy of PO- MERANIA.	1715	7243	2190	5373
	16	7386	2407	5557
	17	8196	2108	5020
	18	7896	2138	6231
	Sum	30721	8843	22181
The Principality of HALBERSTAD.	1715	2371	710	1834
	16	2567	759	2542
	17	2759	764	1961
	18	2527	715	2022
	Sum	10224	2948	8359

The

	Years.	Born.	Pair married.	Buried.
The County of HO- HENSTEIN.	1715	528	164	406
	16	639	155	444
	17	644	148	449
	18	612	158	416
	Sum	2423	625	1715
The Principality of MINDEN.	1715	1711	579	1618
	16	1788	564	1829
	17	1991	542	1419
	18	1832	552	1486
	Sum	7322	2237	6352
The City of MEURS.	1715	406	151	386
	16	439	161	331
	17	454	166	281
	18	470	170	368
	Sum	1769	648	1366
In GELDERN.	1715	00	00	00
	16	00	00	00
	17	1990	497	1066
	18	2053	489	1064
	Sum	4043	986	2130
The County of RA- VENSBERG.	1715	2188	679	1987
	16	2410	716	2349
	17	2312	672	1817
	18	2344	641	1951
	Sum	9254	2708	8104
The County of TECKLENBERG.	1715	342	153	513
	16	553	163	543
	17	505	186	370
	18	507	135	387
	Sum	1907	637	1813
The County of LIN- GEN.	1715	628	213	484
	16	699	154	638
	17	697	248	442
	18	706	221	840
	Sum	2730	836	2411
		G 2		In

	<i>Years.</i>	<i>Born.</i>	<i>Pair married.</i>	<i>Buried.</i>
In LAUENBURG and BUTOW.	1715	585	144	362
	16	587	169	420
	17	586	118	366
	18	554	153	321
	Sum	2312	584	1469
In the French Co- lonies.	1715	—	—	—
	16	—	—	—
	17	607	181	564
	18	603	136	639
	Sum	1210	317	1203

The sum total of all that were born in four years - 306246
 ———— of all that were married - 81881 pair.
 ———— of all that were buried - 217941
 More born than buried, in number - 88305

Here is also to be observed, that in the year 1718, there died 84 persons above 91 years old, and 32 above 100; and 1 died in the 116th year of his age. Besides in that very year are reckoned 2088 bastards.

A particular list of all that died in the year 1718, of several borough towns in the kingdom of PRUSSIA, received from the Chancery of Koningsberg.

In the Borough of	<i>Died.</i>	In the Borough of	<i>Died.</i>
Brandenburg	581	—Lotzen	137
—Schacken	346	—Neuhausen	148
—Fischausen	312	—Labiau	249
—Taxium	456	—Raftenburg	275
—Balga	392	—Preufs Holland	264
—Preufs Eylau	319	—Marungen and Liebstadt	206
—Bartenstein	167	—Marienwerder and Riesen-	
—Barthen	185	burg	393
—Ofterode and Hohenstein	277	—Preufs Marck	312
—Sehesten	159	—Tillit	529
—Neudenburg and Saldau	330	—Ragnit	381
—Lyck	141	—Insterburg	} 808
—Oletzko	188	—Georgenburg	
—Angerburg	182	—Salau	
—Rhein	107	—Mummel	556
—Orfelsburg	220	—Schonberg	126
—Johannisburg	141	—Gerdauen and Nordenburg	269
		In	

In the Borough of	<i>Died.</i>	In the three Cities of	<i>Died.</i>
—Gilgenburg	109	Koningsberg	1756
—Teutsch Eylau	41		
—Neuhaff	15	Sum	11077
In all these forementioned places were christened			20994
Pair married			4287
	<i>Died.</i>	<i>Christened.</i>	<i>Married.</i>
In DANTZICK in the year 1718.	1579	1470	446 pair.
In EPPERIES	123	173	

In the royal hospital at LISBON out of 1251 foundlings maintained by the king, without knowing their Parents, there died 469, remained 782.

X. 2. **A** List of those that were born and buried in BRESLAW, *Continued by the same.*
from December 25, 1719, to December 24, 1720. *n. 381. p. 25. Jan. &c. 1724.*

Buried.		Christened.	
From the 25th of December		Males	564
to the 31st,	40	Females	556
In January	160		1120
February	107		
March	139	Married 460 pair	
April	192	Among the dead were	
May	158	Married men	385
June	120	Married women	186
July	131	Widows and widowers	285
August	182	Batchelors	113
September	189	Maidens	113
October	130	Children to ten years	345
November	132	of age	300
December, only till the		Stillborn	53
24th	127	boys	30
		girls	30
	1807		1810

In the year 1720. in LIGNITZ were	In OELS. Christened 180 Buried 203	Buried 6825 Christened 4126
Married 92 pair. Christened 283 Buried 366	In SCHWEIDNITZ. Married 218 pair. Christened 920 Buried 250	In LOBAU. Married 58 pair. Born 160 Buried 355
Among which were 149 children. In JAUER.	In VIENNA. From the first of Janu- ary to the 31st of December.	Amongst which were born 80 boys and 80 girls: buried 95 men and 48 women, be- sides 4 who died in childbed:
Christened of Protestants 100 ch. Buried 175		

childbed: 26 batche- lors and 22 maidens: 36 boys and 42 girls: 25 chrifoms: 7 still- born: 55 widows and widowers. Likewise 51 persons between 60 and 70 years of age: 29 between 70 and 80: 7 betwixt 80 and 90: 1 of 90, and 1 of 99.	viz. 37 married men and 18 married wo- men: 5 widowers and 37 widows, 6 batche- lors, and 18 maidens: 64 boys, 58 girls, &c. In St. ANNABERG. Married 18 pair. Born 105 i. e. 63 boys and 42 girls, among which were two pair of twins, and 4 bastards.	Born 790 viz. 405 boys and 385 girls. Buried 1264 Among which were 233 men and 146 women: 86 batche- lors, and 62 maidens: 233 boys and 195 girls: 9 women in childbed: 98 chri- foms, i. e. 53 boys and 45 girls: 58 still- born, as 36 boys and 22 girls.
In DRESDEN. Married 368 pair. Born 1448 Among which were 719 boys, and 641 girls, legitimate: il- legitimate boys 44 and girls 44. Buried 1733 Amongst which were 255 married men and 182 married women, 189 widowers and widows: 88 young men and 84 young or single women: 883 children, viz. 461 boys and 422 girls, amongst which were stillborn 72, viz. 37 boys and 35 girls.	Buried 180 viz. 96 men and 84 women; among which were 34 married men and 18 married wo- men, 1 in childbed; 12 widowers and 28 widows: 12 batche- lors and 17 maidens: 38 boys and 20 girls, among which was 1 dead born. In SCHNEEBERG. Married 12 pair. Born 89 As 44 boys: 45 girls: among which were 4 stillborn, & 3 bastards. Buried 157 viz. 28 married men and 11 married wo- men: 1 childbed wo- man: 5 widowers and 25 widows: 9 batche- lors and 10 maidens: 68 children, viz. 49 boys and 19 girls.	In BERLIN. Married 669 pair. Born 2276 Buried 2426 In WISMAR. Christened 168 Buried 100 In EPPERIES. Born 171 Buried 116 In RAWITZ. Born 134 and just as many males as females, except two pair of twins. Buried 95 among which were 15 childbed women and 3 stillborn.
In JOHN-GEORGE City. Married 24 pair. Christened 148 i. e. 79 boys and 69 girls, among which were 2 stillborn, and 10 bastards. Buried 243	In LEIPSIC. Married 314 pair.	In DANTZIG. Born 1862 Buried 1610 Married 442 pair. This is merely of the city, and not of the suburbs of Dantzig.

A list of the several cities and towns of the kingdom of PRUSSIA.

In the year 1720.	Chrif- tened.	Pair mar.	Buri- ed.		Chrif- tened.	Pair mar.	Buri- ed.
In Angerberg -	535	88	259	In Neuhausen -	243	62	141
Balga -	638	133	395	Neuhoff -	28	6	10
Bartenstein -	224	63	188	Oletzko -	688	111	261
Barthen -	337	66	246	Ortelsburg -	476	82	330
Brandenburg -	936	213	576	Osterode -	784	92	300
Teutsch-Eulau	100	25	82	Preufs Eulau -	479	112	282
Fischausen -	478	103	270	— Marck -	705	130	478
Gerdaunen -	489	98	206	— Holland -	705	125	557
Gilgenburg -	225	56	137	Ragnit -	930	93	516
Insterburg -	2386	336	1398	Rastenburg -	610	155	452
Johannisburg	378	68	188	Rhein -	482	89	193
Labiau -	616	92	273	Schacken -	576	96	259
Liebstadt -	440	73	343	Schonberg -	276	51	230
Lotzen -	256	45	148	Sehesten -	354	62	181
Luck -	364	65	174	Taxium -	876	157	441
Marienwerder	769	145	641	Tilfit -	1139	187	647
Mummel -	953	168	448	The city of Ko- ningsberg -	1682	474	1402
Neydenburg -	512	104	437				

Of the year 1721 in BRESLAW.

Buried.	Christened.
From the 25th of Dec. to the 31st, 1720.	Males 610 Females 585
January, 1721.	Total 1195
February	
March	Married 405 pair.
April	Among the dead were,
May	Married men 301
June	Married women 157
July	Widows and widowers 208
August	Batchelors 92
September	Maidens 82
October	Children to ten } boys 324
November	years of age } girls 248
December, till the 24th	Stillborn } boys 42
	girls 28
Total 1482	Total 1482

In JAUER.

Buried 114.

Christened 124.

In VIENNA.

Buried 6490.

Christened 4104.

So that there died 2386 more than were christened.

Among the dead were 43 casualties.
Besides 8 Persons of 90 years old.

1	-	-	-	91
2	-	-	-	92
3	-	-	-	93
3	-	-	-	94
3	-	-	-	96
1	-	-	-	98
4	-	-	-	99
2	-	-	-	100
1	-	-	-	105

In DRESDEN.

Buried 1850.	Christened 1396.	Married 404 pair.	
Amongst the buried were	Girls		400
Married men	274	Stillborn	{ males 50
Married women	206		{ females 28
Widowers	42	Among the baptized were	
Widows	238	Boys	701
Batchelors	128	Girls	690
Maidens	93	Bastards	{ males 40
Boys	479		{ females 51

In LEIPZIG.

Buried.										Chry foms	Still- born.	Christened.					
	Married men	Married wo men	Batchelors	Maidens	Boys	Girls.	Childbed women	Males	Females	Males	Females	Widows and widowers	Summa	Males	Females	Total	Pair married
January	28	25	13	11	15	14	1	1	1	2	3	20	134	43	31	74	13
Febr.	17	12	15	9	16	10	2	4	3	7	2	17	114	31	23	54	30
March	28	29	13	12	14	15	0	1	3	3	3	17	138	34	31	65	1
April	31	24	9	10	17	22	2	2	3	2	0	13	135	32	38	70	0
May	25	23	10	9	23	16	3	6	5	0	0	16	136	31	22	53	20
June	28	16	17	4	15	13	2	3	6	2	2	12	120	21	31	52	24
July	7	10	7	5	8	12	2	1	4	0	3	15	74	37	26	63	21
August	14	8	6	6	19	11	3	2	3	3	2	9	86	27	38	65	17
Sept.	14	14	1	2	13	18	2	4	4	1	1	7	81	29	46	75	30
Octob.	17	10	4	7	14	20	6	7	2	7	4	5	103	38	33	71	20
Nov.	12	13	3	6	20	7	1	3	7	2	0	11	85	37	34	71	52
Dec.	16	12	2	12	19	17	10	3	3	2	1	7	94	27	20	47	1
Summ.	237	196	100	93	193	175	34	37	44	31	21	149	1310	387	373	760	229

So that in this year there died 1300. Born and christened 760. Hence there are 540 fewer born than died.

Among

Among the dead were
218 from 60 to 69 years old.

82 70 79
16 80 88
2 90 91

Besides 1 Batchelor of 60 and 2

of 61; and 5 maidens of 60,
62, 66, 70, and 73 years old.

Among the christened were
8 posthumous: 14 twins: 63
bastards: and 2 Jews baptized.

In the MARCK.

Christened 16086 amongst which were 596 bastards.

Married 4613 pair.

Buried 13511

More born 2575 than buried.

Among the buried were 28 persons of 90 years old and upwards,
besides 3 of 100, 1 of 101, 1 of 102, 2 of 104, 2 of 107, and
1 of 112 years.

In the whole ROYAL PRUSSIA.

Born 75275. Buried 58017. So that there are

Born 17258 more than buried.

The special list of the kingdom of PRUSSIA.

	Chris- tened.	Pair mar.	Buri- ed.		Chris- tened.	Pair marr.	Buried.
In Angerberg	518	104	282	Neuhausen	234	59	138
Balga	605	168	381	Neuhoff	34	10	40
Bartenstein	278	65	218	Oletzko	631	103	312
Barthen	357	64	208	Ortelsburg	497	92	282
Brandenburg	944	222	695	Ofterode	369	144	183
Dutch-Elau	103	20	78	Preufs Eylau	503	113	428
Fifhausen	498	112	300	Holland	605	166	376
Gerdaunen	490	75	219	Marck	657	134	335
Gilgenburg	110	37	76	Ragnit	791	95	336
Insterburg	2235	359	889	Rastenburg	738	165	537
Johannisburg	463	76	174	Rhein	416	108	211
Labiau	569	92	277	Schacken	514	87	326
Liebstadt	431	94	252	Schonberg	255	61	147
Lotzen	247	68	180	Sehesten	330	80	233
Lyck	352	96	183	Taxium	870	159	508
Marienwerder	765	162	400	Tilfit	1245	185	584
Mummel	914	193	522	The cities of			
Neydenburg	545	121	326	Koningsberg	1655	424	1776

Total 20768 4313 12412

Bills of Mortality, &c.

PART IV.

In RATISBON.

Christened Males	_____	130
Females	_____	120
Total	_____	250

Amongst which were three pair of twins, viz. 2 boys and 4 girls; besides 6 bastards, i. e. 3 boys and 3 girls.

Buried 220. viz. married men 41; married women 43; young men 11; young women 15; children 110; i. e. 67 boys and 43 girls; amongst which, widows 23; lying-in women 2; stillborn 2; married 67 pair.

In NURNBURG.

Buried.		Christened.	
Married men	234	Males	_____ 541
Married women	257	Females	_____ 543
Batchelors	48		
Maidens	73	Total	1084
Boys	232		
Girls	191	21 more born than died; amongst	
Stillborn	18	the christened were 16 pair of	
In the Suburbs	10	twins.	
Total	1063		

In COPENHAGEN.

Born 2630.

Buried 2247.

In AMSTERDAM.

The following list contains 7 years, viz. from 1715 to 1721.

Anno 1715 died 7633 persons.

16	7078
17	7451
18	8644
19	9726
20	7820
21	7632

In EPPERIES.

Born 214.

Buried 142.

In DANTZICK.

Born 1833.

Buried 1435.

Married 457 pair.

In LEIPZIG.

Buried.

Chry-	Still-
forms	born.

Christened.

	Married men	Married women	Bachelors	Maidens	Boys	Girls	Childbed women	Males	Females	Males	Females	Widowers & widows	Summa	Males	Females	Total	Pair married
January	13	6	9	4	20	23	3	4	0	5	3	11	101	44	21	65	25
Febr.	17	11	11	8	14	7	0	3	3	4	2	13	93	30	26	56	21
March	10	6	3	4	21	11	3	9	1	6	2	8	84	36	31	67	29
April	19	9	4	10	17	8	1	3	3	1	2	15	92	39	28	67	0
May	19	13	13	2	20	14	2	5	2	2	4	15	111	39	41	80	53
June	11	7	4	2	22	26	0	4	2	5	5	1	89	40	35	75	23
July	11	8	4	2	24	22	3	4	3	1	2	3	87	40	39	79	55
August	8	5	6	8	16	9	1	4	3	2	4	2	68	40	34	74	27
Sept.	8	3	1	1	19	14	1	3	2	1	2	6	61	34	43	77	22
Octob.	6	9	4	5	12	8	1	6	1	3	6	4	65	49	30	79	24
Nov.	11	7	3	3	10	14	1	7	0	1	2	5	64	33	38	71	76
Dec.	11	7	4	4	19	13	0	6	3	4	2	6	79	39	39	78	6
Summ	144	91	66	53	124	169	16	58	23	35	36	89	994	463	405	868	361

So that in this year there died
994, and were christened 868.
Hence there are 126 fewer born
than died.

Among the christened were 2
posthumous, 12 twins, 99 bas-
tards, 1 foundling.

Among the dead were
78 from 60 to 69 years old.
50 70 79
15 80 98

In WEIMAR.

Buried 143. Christened 190. Among the latter were 107 boys
and 83 girls, and among these were 6 twins and 1 bastard. 73 pair
were married.

In BERLIN.

Buried 2499. Christened 2701. Among which were 260 bastards.
Married 742 pair. So that there were 202 more born than buried.

The special list of the kingdom of PRUSSIA.

	Chri- stened.	Pairs marr.	Buri- ed.		Chri- stened.	Pairs marr.	Buri- ed.
In Angerberg	565	92	212	In Dutch-Elau	157	20	54
Balga	604	145	400	Fischausen	473	105	405
Bartenstein	268	42	124	Gerdauen	545	92	187
Barthen	309	97	170	Gilgenburg	205	63	98
Brandenburg	937	223	546	Insterburg	2047	381	1013

Johannisburg

	Chrif- tened.	Pairs marr.	Buri- ed.		Chrif- tened.	Pairs marr.	Buried.
In Johannisburg	382	68	191	Preufs-Elau	490	96	276
Labiau -	608	99	280	— Holland	666	147	334
Liebstadt -	443	76	179	Marck -	142	170	287
Lotzen -	263	57	110	Ragnit -	803	109	371
Lyck -	360	93	119	Rastenburg -	553	118	301
Marienwerder	791	185	398	Rein -	551	81	174
Mummel -	913	225	521	Schacken -	524	130	390
Neydenburg -	674	153	301	Schonberg -	279	66	114
Neuhausen -	217	62	141	Sehesten -	356	76	137
Neuhoff -	37	2	25	Tapiau -	846	176	401
Oletsko -	726	123	270	Tilsit -	1267	218	632
Ortelsburg -	501	91	260	The cities of			
Osterode -	506	97	207	Koningsberg	1664	442	1688

Total 20672 4420 11316

	Chrif- tened.	Pairs marr.	Buried.
In Cuhrmarck Brandenburg	18334	4732	11602
Neumarck	7509	1705	4047
The Dukedom of Magdeburg	8402	2264	6006
Cleve and Mark	6921	1886	5740
Pomerania	7256	1858	4424
Halberstadt	2899	724	2040
Hohenstein	589	151	403
Minden	2140	479	1351
Ravensberg	2270	605	1600
Mors	491	160	369
Geldern	1686	447	1449
Tecklenburg	579	118	398
Lingen	729	242	529
Lauenberg and Butow	630	156	372
French Colonies	663	130	572
Of all the King of Prus- sia's dominions	Sum	81770	20077 52218

So that there were 29552 more christened than buried ; among the dead were 71 above 90 and 100 years of age ; and 1 of 120.

In NURENBERG.

Buried		Born	
Married men	194	Males	501
Married women	233	Females	554
Batchelors	42		
Maidens	61		Sum 1055
Boys	285		
Girls	230		Among which were 12 twins.
Stillborn	12		
	Sum 1057		

In COPENHAGEN.

Born		Married	Buried
Males	1345	785 pair	1999
Females	1256		

2601

So that there were 602 more born than buried.

In AMSTERDM died 8421.

In EPPERIES were born 213, buried 135

In DANTZIG were born 2692, married 490 pair, buried 1442

In RAWITZ were born 200, buried 74

The bills of mortality of the year 1723. from the Acta Breslaviensia.

In BRESLAW

Buried:	282	Chriftened.		
From the 25th of Decr to		Males	711	
the 31st, 1722	22	Females	684	
January 1723	118			
February	114		1395	
March	122			
April	102	Married	422 pair.	
May	115	Among the dead were		
June	119	Married men	220	
July	93	Married women	118	
August	124	Widows and widowers	150	
September	124	Batchelors	48	
October	85	Maidens	46	
November	114	Children to ten (boys	369	
December till the 24th	69	years of age } girls	306	
		Stillborn } boys	38	
	1321		girls	26

1321

In

In VIENNA.

Buried 5443 ; among which were 1079 men and 974 women, 1758 boys and 1632 girls. Christened 4457.

In LOBAU.

Buried 171. Christened 226, and 70 pair married.

In FREYBERG.

Buried 321. Christened 362.

In DRESDEN.

Buried 1654 ; that is, 165 married men, 136 married women, 36 widowers, and 138 widows, 68 batchelors, 64 maidens, 580 boys, and 467 girls.

Stillborn boys 54 and girls 46. Christened 1510 ; that is, 756 boys and 754 girls ; among which were bastards 66 boys and 41 girls : married were 396 pair.

In LEIPSIG.

Buried 928 ; among which were 126 married men and 88 married women, 53 batchelors and 36 maidens, 199 boys and 164 girls, 21 women in childbed, new-born boys 60, and girls 46, besides stillborn boys 37, and girls 30 ; also 68 widows and widowers. Christened were 966 ; as 489 boys and 477 girls ; among which were 11 pair of twins and 99 bastards. Married have been 306 pair.

In ERFURT.

Buried 448. Christened 666.

In the elector of Mentz's dominion, in 75 villages are buried 543, christened 872.

In BERLIN.

Buried 2618. Christened 2770 ; among which are 289 bastards.

In the towns and villages of the Old, Middle and Uckermark are christened 19058, among which are 995 bastards. There were married 4943 pair, and buried 13317 ; among which were 23 who lived to 90, 100, and 1 to 112 years old ; so that there were 5741 more born than buried.

In the rest of the king of PRUSSIA's dominions.

	Born.	Married.	Buried
In the Kingdom of Prussia	21384	4957	10762
In the electorate of Brandenburg	18774	4863	13015
In Newmark	6907	1813	4193
In the dutchy of Magdeburg and county of Mansfeld	8858	1781	5579
In Cleve and Mark	6645	1924	6848
In Pommern	8544	2241	5294
In Halberstad	2943	808	2162

In

Bills of Mortality, &c.

PART IV.

In Hohenstein	604	165	389
In Minden	2087	565	1925
In Ravensberg	2061	613	1833
In Moers	484	156	371
Geldern	1866	436	1478
In Tecklenburg	475	141	437
In Lingon	701	270	641
Latzenberg and Butow	588	149	340
French colonies	594	177	563
	83515	21059	55830

Among the born are 2157 bastards, and among the buried 77 that were above 90 and 100 years old. So that there were 27685 more born than buried.

In COPENHAGEN were born 2604, buried 1914, married 701 pair. Therefore 690 more born than buried.

In AMSTERDAM there died 7119, and were married 2289 pair.

In EPPERIES, born 203, died 132.

In DANTZIG, born 2002, buried 1495, and married 537 pair.

The same by
Dr. Scheuch-
zer for 1724
and 1725.
N. 409. p. 110.
May &c. 1729.

K. 4. A List of those that were born and buried at BRESLAW in the year 1724.

Buried.	Among the dead were
From the 25th to the 31st of	Married men 231
Dec. 1723.	Married women 148
In January 1724	Widows and widowers 154
February	Batchelors 57
March	Maidens 66
April	Children to ten } boys 417
May	years of age } girls 326
June	Stillborn } boys 36
July	girls 31
August	177
September	141
October	134
November	126
Dec. 1. to Dec. 24.	97
	Total 1466
	Christened.
	Males 709
	Females 613
	Total 1322
	Married 386 pairs.

In VIENNA.

Buried 5524; among whom	2 of 96
3 of 90 years of age	1 97
2 92	3 98
2 93	1 99
5 95	2 100

3 of

3 of 101 27 of 90 and upwards.
2 of 103 Christened 4427.
1 of 106

At LUBAU.

Buried 135. Christened 166. Married 38 pairs.

At LAUBAN.

Christened		Buried	
Boys	107	Children	{ boys 68
Girls	116		{ girls 61
		Infants	23
		Stillborn	17
		Widows and widowers	18
	Total 223		
Buried			
Married men	29		
Married women	19		Total 257
Batchelors	7		
Maidens	15	Among which there died 97	
		children of the small-pox.	
		There were married 73 couple.	

At DRESDEN.

Christened		Buried	
Boys	715	Batchelors	72
Girls	712	Maidens	71
Bastards	{ boys 60	Children	{ boys 522
	{ girls 70		{ girls 508
		Stillborn	{ boys 58
			{ girls 40
	Total 1557		
Buried			
Married men	161		Total 1761
Married women	151	Being 204 more than were	
Widowers	35	christened.	
Widows	143	Married couple 413.	

At LEIPSICK.

Christened	
January	79
February	71
March	99
April	78
May	74
June	69
July	78
August	94
September	79
October	79
November	50
December	63

Total 913

Christened in all 913. Boys 491, girls 422; among whom there were three children at one birth, born the 31st of October, one being alive, the two others stillborn, besides 14 twins.

Buried.

Among which

In January	53	Married men	122
February	78	Married women	81
March	87	Batchelors	51
April	109	Maidens	44
May	100	Children { boys	234
June	74	{ girls	210
July	90	Women in childbed	17
August	86	Infants { boys	59
September	77	{ girls	28
October	73	Stillborn { boys	33
November	70	{ girls	28
December	64	Widows and widowers	54

Total 961

Total 961

Married couple 276.

At ERFURT.

Christened	659
Buried	612
Married couple.	188

At Salfeld.

Christened	119
Buried	90
Married couple	24

At GERA.

Buried		Christened	
Married men	28	Boys	153
Married women	15	Girls	143
Widowers	4		
Widows	22		
Batchelors	6		
Maidens	4		
Children { boys	76		
{ girls	42		

Total 197

Including 10 stillborn.

Total 296
Including 6 twins; one of which was stillborn.

Married couple 82.

At BERLIN.

Christened	2798
Buried	2492
Married couple	864

In

In all the king of PRUSSIA's dominions.

	Born.	Married couple.	Buried.
In the Kingdom of Prussia	21685	4611	13680
Churmarck Brandenburg	19507	5019	12242
New Marck	7044	1838	4285
Dukedom of Magdeburg and county of Mansfeld	8584	2073	6035
Dukedom of Cleves and county of Marck	6949	2071	7182
Dutchy of Pomerania	8168	1949	5670
Principality of Halberstadt	2889	781	2326
County of Hohnstein	523	171	322
Principality of Minden	2203	684	2030
County of Ravensberg	2417	680	2166
Principality of Mirs	426	166	529
Dukedom of Geldren	1861	420	1860
County of Teklenburg	427	146	517
County of Lingen	769	255	647
Lauenburg and Butow	607	133	361
French colonies	711	185	546
Total	84910	21182	61182

Among the christened were 2215 bastards; among the dead 66, who lived to 90, and upwards as far as 100.

At REGENSPURG, among the Protestants.

Christened	Buried
Boys 172	Batchelors 13
Girls 126	Maidens 7
Total 298	Children { boys 79 girls 110 }
Among which were 5 twins.	Total 289

Buried	
Married men 34	
Married women 46	

Including 13 widows and four that died in childbed.

Married couple 68.

At AMSTERDAM.

Buried	7622
Married	2294

At VENICE.

Buried	4590
Born	5046

Bills of Mortality, &c.

At COPENHAGEN.

PART IV.

Christened		Buried	
Boys	1306	Men	486
Girls	1183	Women	343
		Boys	991
		Girls	931
Total 2489		Total 2751	

being 262 more than were born, and 837 more than there died in this city the year before; this extraordinary mortality was ascribed to the small-pox being very rife.

Married couple 748

At DANTZICK.

Christened	1999
Married couple	488
Buried	1872
or 377 more than the year before.	

Bills of mortality for the year 1725.

At BRESLAU.

From Dec. 25 to 31, 1724.		Among which	
January 1725	125	Married men	259
February	115	Married women	153
March	129	Widows and widowers	158
April	166	Batchelors	64
May	122	Maidens	58
June	106	Children to ten boys	364
July	121	years of age girls	306
August	107	Stillborn boys	44
September	115	girls	35
October	141	Total 1441	
November	97		
Dec. 1 to 24	67	Christened	
		Boys	664
		Girls	675
Total 1441		Total 1339	
		Married 363 couple.	

At

Buried	
Men	1007
Women	1433
Boys	1865
Girls	1560

Total 5865

Among which

8	of	90
1	-	91
3	-	92
2	-	93
1	-	94
3	-	95
2	-	96
2	-	98
1	-	99
3	-	100
1	-	102
1	-	103
1	-	106

29 of 90 and upwards.
Christened 4708

At DRESDEN.

Christened		Buried	
Boys	758	Married men	225
Girls	714	Married women	174
Bastards	{ boys	Widowers	36
	{ girls	Widows	65
		Batchelors	99
Total 1600		Maidens	167
		Children { boys	478
		{ girls	398

Total 1642

Among which

Stillborn	{ boys	53
	{ girls	32

Married couple 519

At

Bills of Mortality, &c. At LEIPSICK.

PART IV.

Christened

Boys

478

1 Jew, 20 years of age

Girls

461

Total 940

Among which were posthumous births 6; twins 12; bastards 141;
and among them 3 twins.

Married 260 couple.

Buried

Married men - - - 113

Married women - - - 75

Batchelors - - - 49

Maidens - - - 34

Boys - - - 165

Girls - - - 106

Women in childbed - - - 10

Children 5 boys - - - 58

2 girls - - - 51

Stillborn 5 boys - - - 45

2 girls - - - 24

Widows and widowers - - - 77

Total 807

At ERFURT.

Buried 617

Christened 624

Married 183 couple.

At COBURG.

Christened

Boys

Buried

Married men

35

Girls

Married women

35

Total 206

Women in childbed

2

Among which 3 twins and 8

Batchelors

4

bastards.

Maidens

10

Children

96

Total 182

Six of which were stillborn.

According

According to the months.

	Christenings	Burials
January	17	22
February	27	13
March	24	18
April	18	20
May	16	11
June	15	10
July	12	18
August	10	14
September	21	13
October	23	15
November	11	9
December	12	19

Total 206

183

Married couple

46

At REGENSPURG among the Protestants.

Christened	Buried	
Boys 142	Married men 42	
Girls 126	Married women 39	
	Batchelors 13	
268	Maidens 11	
Among which 4 twins.	Children { boys 58	
	{ girls 50	
	Total 213	
	Married couple 80	

At FRANCKFORT on the Mayn.

Christened	
Boys 346	
Girls 385	

731

Including 10 twins, 4 posthumous births, 1 Jew, 2 foundlings, and 22 bastards.

Buried 843

Christened at SACHSENHAUSEN

Boys 87	
Girls 79	
166	

Including 2 twins and 9 bastards.

Buried

Buried at SACHSENHAUSEN 18.

Married pairs at FRANCKFORT and SACHSENHAUSEN 209.

Marriages at AMSTERDAM in the reformed church.

In 1724 2294

In 1725 2249

At VENICE.

Born 4836

Buried 4816

At DANTZICK.

Christened 2012

Buried 1678

Married couple 46

*An extraor-
dinary cure by
sweating in
hot turf, with
a description
of the Indian
hot houses.
By Paul
Dudley Esq;
n. 384. p. 129.
July &c.
1724.*

XI. **I**N the year 1704. P. Coffin Esq; of Exeter in N. England, being then 74 years old, by drinking cold water in a very hot day after he had heated himself in the woods, got a surfeit which settled principally in his right side, but gave him a racking pain all over his body, and particularly deprived him of the use of his right arm. In this condition he kept his bed for nine weeks, and his recovery was despaired of, till his son from whom I had the relation, proposed sweating him in turf: the father readily agreed to it, having used many medicines without any effect, and orders were immediately given to cut a large oven full of turf; the pieces were about eighteen inches square; of English grass, and only the sward, or top of the earth, with the grass. Before the turf was put into the oven, the doctor rubbed the grassy side of the turf with some spirit or oil, and then doubled the grass-sides together. After about two hours baking he took them out, and having made a bed of them upon the floor, and then ordered his father without his shirt, but wrapped up in a sheet, to be laid upon it, and to be covered over with the rest of the turf, more especially on the side where the seat of his pain was, but none to be laid on his breast or head; then they covered him with blankets to keep the heat in, and gave him warm cordials to prevent his fainting, which he was in great danger of; after he had lain thus about three quarters of an hour, which was as long as he could bear it, he was put naked into a bed very well warmed, where in a few minutes he fell asleep and sweat to that degree, that it run thro' his pillow and bed, upon the floor. After about two hours sleep they dry'd him and put him on warm cloaths, and he found himself much eased and refreshed. This was in the morning, and before night he walked about the house, his pain being in a manner all gone; next day the doctor repeated his cordials, and the fourth day he sweated him a second time in the same manner; and the fifth day he went abroad about his business, and lived eleven years afterwards in perfect health and free from pain.

pain. The doctor says great care must be taken that the patient do not lie too long in the turf, and that even a quarter of an hour may be sufficient for some persons; and when'er the patient begins to fetch his breath short or faint, he must be put to bed immediately, and by no means omit his cordials. I should have been glad to have made this account yet more perfect by acquainting you what specific the doctor put upon the turf before he set it in the oven, but I could not possibly prevail upon him to tell me.

Houses to sweat in were common among the Aborigines, when the English first came into N. England, tho' now but little used. A gentleman of the island of Nantucket where the Indians sometimes practise it even at this day, or very lately, gives me the following account of them. *The Indian hot-bouses.*

The cave is usually four foot high, and about eight diameter, dug in the side of a hill, and as near as may be to some place of water, the roof being supported with sticks or boards covered with earth. The entrance into it is small, and the door, when any person is sweating, is covered with a blanket or skin; near the cave they make a good large fire, and heat a parcel of stones to the quantity of five hundred weight, and roll them in red-hot, piling them up in the middle of it; when this is done, the Indians go in naked, and sit round the heated stones; as soon as they begin to grow faint, which may be in a quarter of an hour, they come out and plunge themselves all over in the water † for a minute or two, and then in again, as long as they can well bear it, and so into the water a second time, and then dress themselves. This has been used with success for colds, surfeits, sciatica's, and pains fixed in the limbs, by the English as well as the Indians. I don't understand but that it may be practised at any time of the year without hazard or inconvenience. The Indians often used it before and after long journies, hunting, or voyages to strengthen and refresh themselves. † Vide supra §. IV. p. 40, 41.

XII. **A**S we have a species of the scabiosa here which is of great virtue in removing intermitting fevers, I thought proper to send you a specimen of its upper leaves, the lower being at present dried up. It is not unlike the figure which Morison gives of his 20th species †, or of his 25th species ‡, of corymbiferous plants, only the head is not round as there described. I have therefore presumed to call it, scabiosa, flore pallide purpureo, capitulo oblongo, foliis superioribus incisis, inferioribus integris, serratis. The method of preparing it is to put a handful of it into a quart of water, and boil it away to a pint. A coffee-dish full of this decoction is given fasting a little before dinner and at night to the patient, no regard being had to the interval or intermission of the fit, as in giving the bark; and it operates ordinarily by stool or urine. I have only seen this plant here, at Oran, Gibraltar, and mount Libanus, where I first was acquainted with its extraordinary Qualities. *Of a cure for intermitting fevers at Algier. By Mr. T. Shaw. n. 411. p. 182, O.R.G. 1729.*

† Cap. xxi. Sect. 6. Tab. 14.

‡ Cap. xxi. Sect. 6. Tab. 15.

*An addition
to the de-
scription of
the art of liv-
ing under wa-
ter. By Dr.
E. Halley.
n. 368. p. 177.
May &c. 1721.
† Vide supra
Vol. IV.
P. II. C. II.
§. II.*

XIII. **I**N no. 349. † of the Phil. Trans. I explained the method I had practised and found effectual to furnish air at any reasonable depth under water, and in any quantity desired for the subsistence of men that shall have occasion to work at the bottom under a great pressure of water. This I did by means of the diving-bell, which, being from time to time replenished with fresh air, I had found sufficient to maintain five men for near two hours together in ten fathom water, without the least hurt or inconvenience. But as the bell cannot be moved from place to place without moving the vessel from which it hung suspended, I bethought myself how to enable the diver to go out from the bell to a considerable distance, and stay a sufficient time without it, with full freedom to act as occasion served. And considering that the pressure being greater on the surface of the water in the bell, than on any other surface that was higher than it, the air would by a pipe pass from the bell into a cavity of air over that higher surface; I concluded that putting on a cap of lead made weighty enough to sink empty, and in form resembling the bell itself, I might by flexible pipes, which a man might carry coiled on his arm, receive a constant stream of air from the magazine thereof in the great bell, so long as the surface of the water in the caps was above the level of that in the bell.

Following this idea, I procured pipes to be made, which answered all that was hoped from them. They were secured against the pressure of the water by a spiral brass wire, which kept them open from end to end, the diameter of the cavity being about the sixth part of an inch. These wires we coated with thin glove-leather curiously sewed on, and then dipt the leather into a mixture of oil and bees-wax hot, which filling up the pores of the leather, made it impenetrable to water. Then we drew several folds of sheeps guts over them, which when dry, we covered with a good coat of paint, and then secured the whole with another coat of leather, to keep them from fretting. The pipes, of which we made several, were much about forty foot long, the size of a half inch rope; the one end thereof being fixt in the bell at some height above the water, and the other end fastened to a cock which opened into the cap. The use of the cock being to stop the return of the air, whenever there was occasion to stoop down or go below the surface of the air in the bell, which was necessary as often as there was occasion to go out or return into the bell.

The diver therefore putting on his cap and coyling his pipe on his arm like a rope, as soon as he is discharged from the bell opens his cock, and marches on the bottom of the sea, veering out the coiles of his pipe, which serve as a clue to direct him back again: and this I have seen practised without any ill incident attending it.

But there are two things to be remarked in this affair; first that the weight of a man being very little more than that of his bulk in water,

water, he cannot act with any strength, nor stand with any firmness, especially where any thing of a stream runs, without a considerable addition of weight; and therefore the leaden caps were made to weigh about half a hundred weight, to which I added a girdle for the waste of large weights of lead of about the same weight in the whole; and two clogs of lead for the feet, of about 12 pound each. With this accession of weight I found a man could stand well in an ordinary stream and even go against it. The other thing necessary to be provided against was the cold of the water, which though it could not be wholly taken off so that a man could endure it long, yet it was much eased by a wastecoa and drawers made close to the body, of that thick sort of woollen stuff they make blankets of: this being full of water would be a little warmed by the heat of the body, and keep off the chill of new cold water coming on it.

As long as the water is not turbid things are seen sufficiently distinct; but a small degree of thickness makes perfect night in no great depth: in my leaden caps, which from their use I call caps of maintenance, I at first fixed a plain glass before the sight, but soon found that the vapour of the breath would make such a dew on the surface of the glass, that it hindred its transparency; to remedy which I found it necessary to prolong that side of the cap that was before the eyes, and thereby enlarged the prospect of what was under us.

XIV.

		Weight.		After bathing 12 minutes.		Urine.	
		lb.	℥.				
July 21. 1728. h. 10 $\frac{1}{2}$ at night.	A.	137	12	137	11 $\frac{1}{2}$	3	3
	B.	134	15 $\frac{1}{2}$	134	13 $\frac{1}{2}$		
	C.	169	15	170	—		
	D.	119	6 $\frac{1}{2}$	119	7	4	3
				Urine.	Weight after 1 h.	after bath. 20 min.	
				℥.			
h. 8 $\frac{1}{2}$ morning.	A.	136	9	9 $\frac{1}{2}$	135 15	136	—
	B.	134	1	7	133 7	133	11
	C.	168	13	13	167 11	167	14
	D.	118		15	117 —	117	—
h. 11. after eat. cloaths changed.	A.	137	5	After h. 1 $\frac{1}{2}$ exercise chief- ly un. ground in Pool's hole.		Perfp. 10 $\frac{1}{2}$	3
	B.	140	7			13	3
	C.	170	4 $\frac{1}{2}$			—	lb
	D.	117	8			8 $\frac{1}{2}$	3
Aft. din. cloaths changed.	A.	136	14	3	Perspiration in $\frac{1}{2}$ h. where note, that all used moderate exercise, walking about, except D, who sat still reading the whole time.		
	B.	142	6 $\frac{1}{2}$	7 $\frac{1}{2}$			
	C.	170	15	3			
	D.	119	1	6 $\frac{1}{2}$			
		Weight.		After 1 h. bath.		After 1 h. persp.	
		lb	℥	lb	℥	lb	℥
Servant who at- tended the Bath.		173	4	173	6	172	15

Statical experiments on the effects of warm bathing. By Mr. J. Martyn. n. 407. p. 26. Jan. Ec. 1729.

Statical experiments on warm bathing. PART IV.

From these experiments may be concluded, 1st, That warm bathing increases the weight of the body for the present; though it causes a plentiful perspiration afterwards; which I do not remember that any one has hitherto observed. 2^{dly}, That the perspiration after this exercise is nothing near so large as Dr. Keill † has delivered; it amounting by his account to one pound and a half in one hour's time. By our observation it is but five ounces in one hour, and from eight ounces and a half to one pound in one hour and a half, though assisted by motion; which might have caused us to perspire, by Dr. Keill's computation †, from three to six ounces.

† Med. Stat. p. 16.

† Ibid. p. 15.

THE END.

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